To the value creators who often
toil without reward or recognition
while speculators loot the system.

Believe nothing because a wise man said it.
Believe nothing because it is generally held.
Believe nothing because it is written.
Believe nothing because it is said to be divine.
Believe nothing because someone else believes it.
But believe only what you yourself know to be true.

—The Buddha

Contents

Prologue

Efficient innovators solve problems, not invent solutions looking for problems.

The global economy was in utter crisis after the fall of 2008. Not only did venerated financial institutions such as Lehman Brothers go bankrupt, but so too did entire nations. Yes, Iceland went bankrupt in October 2008. Ireland did not build a new home for months. In India, construction sites stood unfinished due to merciless credit tightening around the world. Even after receiving $15.4 billion in federal loans, General Motors inched towards bankruptcy, posting a $6 billion loss in Q1 2009. Even China's export-led hyper growth, advanced on the wings of artificially cheap credit in the US market, was slowed.

In 2010, beyond the murmurings of recovery, 30 million Americans remain unemployed. Europe looks to be in no better shape. It is true that the emerging economies are faring better in comparison, but they have a long way to travel yet to lift themselves out of the *developing* and into the *developed*.

Now more than ever, we need discontinuities to crack open innovative new industries and create new jobs. Incrementalism, for all its patient optimism, won't suffice. The time has come for big, bold moves. Yet we hold in our hands a system wholly inadequate.

Remember the Clinton years? Sure, Bill Clinton takes credit for the prosperity, but anyone who pays attention knows the 1990s boom was the innovators' doing. Internet-inspired entrepreneurship washed away most of the $300 billion deficit that haunted the US economy early in the decade.

The Internet created millions of jobs through active entrepreneurship and a Silicon Valley willing to make audacious, visionary investments. John Doerr of Kleiner Perkins Caufield & Byers set the Internet bonanza in motion with his investment in Marc Andreessen's Netscape, followed by Jeff Bezos's Amazon.com. Sequoia's Mike Moritz followed by putting money into the hands of Jerry Yang and his fellow Yahoos. In 1997 the guys at Benchmark backed Pierre Omidyar's eBay, which, as John McCain reminded us during the 2008 presidential debate, today supports the livelihood of 1.3 million people.

Soon, entrepreneurs and venture capitalists were rushing to build companies around e-commerce and search. Many failed, and the market collapsed in 2000, but not before in 1998 it spawned yet another milestone venture: Larry Page and Sergey Brin's Google.

The early years of the twenty-first century might have seemed dry as the economy tried to recover from the dot-com collapse and the tragedy of 9/11, but during those early years a group of entrepreneurs led by Salesforce.com's Marc Benioff laid the foundation for a whole new movement: software as a service (SaaS), which has more recently broadened its scope to cloud computing. The bulk of Silicon Valley's VCs missed this trend in the beginning, with one notable exception: Brian Jacobs, Jason Green, and Gordon Ritter started a firm called Emergence Capital at a time when Silicon Valley remained attached to business models built around "products." Emergence Capital would, instead, invest in "services" companies. Today, its leadership has played a pivotal role in creating a thriving and abundantly funded software-as-a-service ecosystem.

John Doerr's remark, in the middle of the 1990s boom, that the Internet was "underhyped" provoked more than a few snarky comments. But he was right. Now we have SaaS, Web 2.0, and

cloud computing – with Web 3.0 just over the horizon.

Doerr and Vinod Khosla, his former Kleiner colleague, also provided exemplary leadership in jump-starting the cleantech industry. T. J. Rogers, then chief executive of Cypress Semiconductor, spotted the trend early as well and invested in SunPower, one of the darlings of the solar energy boom. From electric cars to alternative energy, and clean air to clean water, those early successes are validating the industry's potential to create wealth. Entrepreneurship is active, jobs are being created, and problems are getting solved.

In all of this the leaders of the innovation ecosystem have identified problems, found technology-leveraged solutions, and gone beyond building companies to building industries. We must rise to the challenge again. Education, healthcare, social security – these domains need our voices, our intellect, our credibility, our time, and our money. In each of these domains, there are early successes: Ron Packard is breaking through the education morass with K12; Jonathan Bush is cracking healthcare with athenahealth. Their experiences offer deep insight into alternative business models, marketing models, and approaches to problem solving – most notably using advertising dollars to fund teachers, students, doctors, and patients, as we have seen with HotChalk in education and Epocrates in healthcare.

On the shoulders of smartphone advancements, can we not create seamless bridges between doctors, patients, and insurance providers, slashing the $250 billion expenditure in healthcare administration? And for teachers both at home and abroad, can we not create a body of standardized content and methodology? One that includes parents and engages children via "edutainment" the same way Facebook and *World of Warcraft* engage kids?

Innovators of the world, your answer to all these questions must be yes. Don't let the current miasma of fear slow you. You have to lead. You have to create. You have to build.

In earlier volumes, I have discussed today's dysfunctional venture capital industry, which threatens to hobble tomorrow's innovation. As a work-around, I have offered bootstrapping as a weapon of mass reconstruction. But while software, content, and certain Internet ventures can be bootstrapped, there are many types of innovation that cannot. Hardware. Chips. Cleantech. Biotech. These require long gestation cycles, up-front R&D investment, and several years of red-ink financing before the original hypothesis can be validated.

Many of the leading thinkers on innovation are extremely concerned about the future as the venture capital industry has become systematically risk averse. "A complex shift in these environmental factors has thrown America's innovation ecosystem off balance, threatening the way of life that we now take for granted," writes Judy Estrin in her book, *Closing the Innovation Gap*.

With VCs hedging their bets, entrepreneurs need to become savvy at navigating the complexities of the systemic roadblocks. In this volume, I offer a multitude of lenses through which entrepreneurs can look at innovation in its various forms and decide on the right course of action for themselves. And as before, I have included a discussion on bootstrapping and shoestring innovation, which still remains one of the most practical ways to circumvent the early-stage fund crunch while maintaining control and freedom.

This being said, the venture capital industry has to work effectively as part of the innovation ecosystem. It is not a sustainable situation if entrepreneurs have to constantly find work-arounds to circumvent VCs.

Above all, while unbridled Wall Street gambling has brought the world economy to its knees, on the innovation side there is today an urgent need for more risk, not less. For innovation is the dire need of this dark hour.

Legendary Innovators

Innovation, Need of the Hour

I met Nassim Nicholas Taleb in San Francisco's Fort Mason Center in the summer of 2008. Taleb is now famous for *The Black Swan*, a book through which he popularized the idea that random accidents and uncertainties – he calls them Black Swans – determine the course of history and with it the trajectory of people's lives. Such a lack of individual control begs questioning. So I asked him, "What are you going to do about your thesis?"

His answer: "I don't do. I just think and write."

For the moment, I have also been thinking and writing. About technology. About entrepreneurship. Policy. Economics. Capitalism. My thinking has led me to conclude that innovation is the crucial need of the hour. Innovation in education. In energy. In water. Medicine. Healthcare. Finance. Government.

While we know that many innovations are accidents, I'm not sure they are necessarily random. The Internet, for example, came out of a sustained R&D effort spanning some 35 years. Various pieces of the puzzle fell into place in the mid-1990s, giving us a great discontinuity – an innovation of a magnitude unknown for decades – upon which markets, industries, jobs, and the development strategies of entire nations have been created.

Now what we need is a few more Internets.

Easy to say, extraordinarily hard to do. Especially within our ailing system. One where speculators are compensated above creators, where a systemic aversion to risk has blockaded economic growth, where venture capitalists behave like bankers, and where Wall Street obsesses over quarterly results, discouraging long-term R&D.

"Not all innovation challenges can be met with a $500,000 seed investment and a cash-flow-positive model within the first year," says Eric Benhamou, former CEO of 3Com and Palm. "The preferred, risk-limited model of the venture capital industry will leave many important problems unsolved, many large-scale opportunities unaddressed, and many radical innovators unfunded."

"A willingness to take intelligent risks and try something new is critical to both innovation and entrepreneurship," writes Judy Estrin, a long-time entrepreneur and author of *Closing the Innovation Gap*. "But the last decade has seen an increasing focus on short-term returns through risk taking without questioning or transparency to even understand the real level of risk. As a result, we replaced the foundation for real economic growth with the illusion of prosperity."

Both Estrin and Benhamou have for decades been major movers and shakers in their fields (Estrin in networking; Benhamou in both networking and handheld devices, the precursor to the now widely popular smartphone). They share, too, a deep concern: that our industries have become riddled with short-term thinking, a desire for instant gratification, a lack of vision, and unbridled
greed – none of which support a culture of innovation, which had been America's core strength.

Among the pieces of the innovation puzzle that need to fall in place is a well-oiled university-industry-government collaboration machine. One that creates adequate incentive to retain our greatest minds in research and technology and quells the brain drain we have all witnessed as our best and brightest abandoned these undervalued sectors for finance. We need a system that rewards long-term, sustained effort in solving humanity's biggest problems, not one driven by unbridled greed.

Much has been written recently about Ayn Rand's classic, *Atlas Shrugged*. In Rand's book, the captains of industry go on strike when the government decides to redistribute wealth. In our modern society, of course, the problem is substantially more complex. It is no longer a government versus private sector issue. Instead, there's a terrible triangle of competing interests: the creators (those who add value) versus the speculators versus the government.

The system is so deeply flawed that our traders are richly rewarded for the ignoble work of shorting stocks, spreading rumors, and destroying value. Whatever system emerges as we debug Capitalism 1.0, there is no doubt in my mind that the cornerstone of that system must be innovation and entrepreneurship. Capitalism 2.0 must be fundamentally rooted in justice – justice for entrepreneurs – unless we want to see our value creators go on strike, leaving the speculators with nothing to speculate on and the government with no wealth to redistribute.

Judy Estrin

Judy Estrin has been named three times to Fortune *magazine's list of the 50 Most Powerful Women in American Business. She sits on the board of directors of the Walt Disney Company and FedEx Corporation, and she is a longtime technology industry innovator, having co-founded Bridge Communications, Precept Software, and Packet Design LLC, which spun out another three networking companies.*

SM: Judy, you are a legend in Silicon Valley. Take us back to where your story begins. Where are you from, where did you grow up, and what is it in your DNA that got you into all of this? JE: The part that's in my DNA is a love for science and technology.

I grew up assuming you didn't do something unless you had a passion for it. I think one of the hallmarks of entrepreneurship is that passion.

It never occurred to me that you could have a job just to have a job. The part that was a surprise was my being an entrepreneur and a leader. I never expected that when I was younger. Both of my parents were electrical engineers. My father worked on the original computer architecture, and my mother got her PhD at a time when only one other woman in the country had completed a PhD in electrical engineering.

My father was one of the founders of the computer science department at UCLA, but at the time there were nepotism laws, so my mother couldn't actually work in the EE department when my dad was there. So she became one of the very first biomedical engineers and ran the data processing lab in the Brain Research Institute at UCLA. She did research on brain imaging in a time when nobody knew what biomedical engineering was.

So I was brought up in a household steeped in science. My older sister is an MD, and my younger sister is a professor of computer science. I did my undergrad at UCLA, in math, focusing on computer science. There was no computer science department since the field was just beginning. I did my master's at Stanford, in EE with a concentration in computer engineering. When I did my master's, my adviser was Vint Cerf, often referred to as the father of the Internet. As it turns out, Vint was one of my father's PhD students. Another of my father's students was Paul Barren, one of the inventors of packet switching, the technology that underlies it all. When I was at Stanford, I was a junior member of the team that built the TCP protocols, which became the backbone of the Internet.

Sometimes you make decisions that, at the moment you're making them, you have no idea how they're going to influence your life. When I got out of Stanford, I had offers from Xerox, HP, and Intel, and then I had an offer from this 50-person company called Zilog, which was a spinout of Intel. I was interviewing as a software engineer, and the traditional path would have been to go to one of the big companies. But I ended up going to Zilog because a friend of my parents told me the smartest people he knew worked at Zilog. So right out of school in 1976, I chose to go to a 50-person company.

It ended up being an incredible decision for me. I did some computer architecture and software work for a couple of years, but I found I really enjoyed leading and being in management. I led the project that essentially shipped the first commercial local area network, something called Z-Net.

Zilog is also where I met Bill Carrico, my now ex-husband, who then became my business partner of 25 years. He was my boss at Zilog, and in 1981 we decided to start Bridge Communications. I was 26, and he was 31. Young people founding companies is now a common story, but at the time it wasn't. Bridge Communications was our first company.

SM: In several of the turning points you've described up until now, your father seems to have had a mentoring role. Was that an active role? JE: Yes and no. My father and mother both had very significant influences on me, but in different ways. My ending up in computer science was in many ways my following in my father's footsteps. My mother and father's combined influence led me to believe I could do whatever I wanted when I entered the world and the workplace. I never questioned being a woman in a man's world. I had a built-in role model. I didn't even think about it. Unlike some women of my generation, I think that's one of the things that helped make me successful – that I never had a chip on my shoulder about being a woman. I just did what I did, and I ended up very often being the only woman in groups of men.

SM: I have never even thought of myself as a woman. I think of myself first and foremost as an entrepreneur, a professional. JE: I thought of myself as a technologist first. When I became a leader and manager, I thought of myself as a businessperson first and a woman second.

SM: Where did your business acumen come from? JE: That's the part that was a surprise. There was nothing in my upbringing that intersected with the business world. Both of my parents were academics. When I ended up getting more interested in entrepreneurship and the business side, I found that I really loved technology, but what I really loved doing was solving problems in general. The reason I love managing, developing people, and creating companies is that it's all about problem solving.

I am not a nerd. My definition of a nerd is someone who likes computers more than people. Although I have a strong technology background and I like technology, I love interacting with people. I view technology as a way to solve problems people have. I had that mindset when I was an engineer, as well as when I was involved in the marketing and sales.

When Bill and I co-founded all of these different companies, in the first couple he was CEO and I was executive vice president. At the second company I became CEO partway through, and at the third company I was CEO.

SM: Let's talk about the founding situation of Bridge and what was going on in your environment that delivered you to its conception. JE: At Zilog I was involved with the first commercial local area network. At the time, we hadn't standardized on Ethernet. People didn't understand the power of hooking computers together. We were starting to see companies popping up with different, incompatible technologies, and the idea behind Bridge was to interconnect those disparate networks. But when Bill and I started to flesh out the business plan and talk about it, we realized there wasn't enough of an install base of networks to have enough of a business to interconnect those networks. We adjusted the business plan, and even though we kept the name Bridge and continued with products that were bridges and routers, we decided our first part of the business would be to sell communication servers that actually created the networks themselves. It was critical.

This is something entrepreneurs need to think about in the business-planning phase.

> ***We were very passionate about this idea of interconnecting networks. However, we were not so passionate and so fixated that we were unwilling to realize that the interconnect business opportunity would take longer to develop and that it was too far ahead of its time.***

We kept that as our vision, but we managed to build a product that could easily do both from a hardware perspective by changing the software and interfaces, which was a critical part of what ended up being Bridge's success. Cisco talks about shipping the first router, but in fact Bridge shipped the first router.

SM: Tell me about how VCs received your concept when you were starting Bridge. JE: Bridge started in 1981, and we spent six months trying to raise money. I remember one VC asking why we needed $1.8 million for a modem. I looked at Bill and said, "He doesn't get it." So we went back over and over and over, refining our pitch, until we found someone willing to go to bat.

It's interesting because we talked to Sequoia at the time, and they decided to pass because we didn't have enough experience. A year later, we were actually doing pretty well and were about to ship our first product. The venture community sensed this was something that was going to take off. At that time Sandy Lerner and Len Bosak walked into Sequoia – Don Valentine's office. He realized he'd missed an opportunity the year before, and the situation looked very similar, a husband-and-wife team and all. So he invested in Cisco – and he's told me personally that part of the motivation for making that investment was realizing he'd missed out on Bridge.

SM: What a coincidence that two husband-and-wife teams would found two preeminent router companies! JE: It is. We went public in 1985, and we were profitable. We decided we needed to embrace PC connectivity and developed a product on our own, but we were strategically thinking about merging with someone as opposed to going into the PC market by ourselves. We merged with 3Com, which was a real lesson learned.

SM: Before we address the 3Com story, what were the highlights of building Bridge? JE: Bridge, for me, is like your first love that you never forget. I remember when we were raising money, and people would tell us we had no experience. We would say it didn't matter – we had the vision and passion. But I can look back and see how little we knew and how much we learned.

We created a market and built the culture of a company. Winning those first orders and convincing those first customers that this was something that could solve problems for them was wonderful. I can still remember a $700,000 RFP that came out from Southwestern Bell. When we won that RFP, it was like, "OK, we're real."

The day we went public is also very memorable. In those days it was a very different thing. There was a sense of excitement and responsibility. Every day was filled with learning experiences. I would not say that about later companies. But that first time we pulled together an incredible group of people and had a wonderful culture. It was like a family, and there was commitment and passion to build products that would solve a problem for customers.

We had a very customer-focused culture. One of the things that was very difficult when we

merged with 3Com was that they sold through distributors. They didn't even know who their customers were, while Bridge had this customer-centric culture.

SM: What did you learn about working with your husband? Today VCs will not fund couples. JE: We weren't married at the time, but we were living together. As my sister used to say, we didn't need to get married, we were incorporated!

But Bill and I made a great business team. We were very complementary in our styles and worked well together. People were nervous about what would happen if we split up. But in our case it worked because we had a huge amount of respect for each other's capabilities, and we really partnered in how we built the companies. Couples who are thinking about starting companies together have to think long and hard about it. It puts extra stress on your personal life because you never get away from it. And it puts extra stress on the company because people need to understand who the boss is. All of those things have to be worked through and communicated. I think VCs *should* do extra due diligence and really understand the dynamic.

You can find lots of business partners who are not married, but who are so synergistic – and have started multiple businesses together – that if the team broke apart, you wonder if either of them would do the same job. In essence, those teams have the same risk. Team dynamics, strengths and weaknesses, and how dependent the team members are on each other are important parts of that. We had the benefit that we both lived and breathed it. There wasn't the issue of coming home and having a spouse ask why we were working so hard.

SM: You merged with 3Com, which has a completely different dynamic and culture. JE: The first and biggest mistake is that we merged with the notion there was going to be an office of the president. Bill Carrico and Bill Krause were sharing the key roles. Bill Carrico was chairman and president, and Bill Krause was CEO, or something like that. I don't remember the exact titles. They were an office of the president. When we decided to merge, we had the notion that Bill Krause was going to retire, so it would be a short-term arrangement. It wasn't, and Bill Krause decided to stay.

Second, we had different strategic views as to where the company was going. Bill and I saw the company as a communications company. Bill Krause wanted to turn it into a computer company with PCs and servers. We had this incredible strategic divide. Bill and I knew we could either take it to the board or we could leave, but having that strategic tension was not going to be beneficial for the company. We decided we didn't want to have a board fight, so we left.

Eric Benhamou stayed and had the patience to wait it out. When the company was not doing well, he presented his renaissance plan, which, in essence, was the communications strategy that we all wanted in the first place. He was then able to bring 3Com back.

After we left, I got a call from Sandy Lerner. We had never met, so we arranged a meeting. All of our old Bridge customers were going to Cisco, and their sales were going through the roof. In many ways our merger with 3Com – and the consequential mismanagement of the Bridge portion of the business – gave Cisco a growth spurt. There is definitely irony there, especially since I became Cisco's CTO a few years later.

SM: What did you do when you left Bridge/3Com? JE: We were going to take six months off, but the day we announced we were leaving we received a call from someone we'd worked with when we were at Zilog. This group of five guys came and pitched a business plan they'd worked on for five months. They had a prototype, but no money. They were unable to raise

money because they didn't have a management team. So we jumped right in; Bill was CEO, and I was executive VP.

SM: What did that company do? JE: It was Networking Computing Devices, which had one of the first X terminals. Essentially, it was thin clients before they were popular. Our first-year sales were $13 million. We came out of the chute very strong.

SM: Market demand was that quick? JE: There was tremendous initial market demand. We took the company public; unfortunately, the year we did that was the year Windows came out, and the price of PCs started dropping. The Unix market started fragmenting. X terminals were sold primarily into the Unix market, and when PCs started taking off, the Unix guys couldn't get together on applications, so their market started going down, which impacted the market for terminals.

By the time Bill and I took the company public in 1992, we'd been going 100% since 1981. We didn't have a single break. Our son was turning four. I'd become the CEO the year prior. I was getting ready to hit a wall. So I found a CEO to replace me, and we left in 1994. Unfortunately, the CEO I found was not the right choice and took NCD down the wrong path.

SM: What did you do after NCD? JE: We took six months off, thinking we would not start anything again. Then six months later we started Precept, which was video streaming software. That was before video streaming was popular.

We had a wonderful product, but it was dependent on multicast. Cisco talked about multicast in all of their white papers as if it was deployed, but it was not deployed. That meant we had a product that was dependent on an infrastructure that was not deployed yet. That made our growth a little slower.

Another thing that was happening was the Internet bubble was starting. It became all about marketing. To be honest, I hated the bubble. When form overcomes substance, I get out of the way.

In 1998, the CTO of Cisco wanted to leave but couldn't until he found a replacement. He came to me and offered to buy Precept, and then I would go be the CTO.

I didn't necessarily want to be CTO, but I knew the company was in a fragile state, the infrastructure was not there. This was the right exit strategy, so I sold the company for $82 million. We had $1 million in revenue. From the time Cisco bought us, the stock went up five times afterwards. They ended up using the technology. They have products that use Precept technology now, and some of the people who went over from Precept are still there. In the end, it was a beneficial acquisition for them.

SM: Cisco was already quite large. What was it like to be inside Cisco? JE: I had sat on the board of big companies prior to that. I went on the board of FedEx in 1989, and in 1995 I went on the board of Sun. When I was at Cisco, the company grew from 18,000 to 36,000 employees. The first two years I was CTO – I ran all centralized software, which accounted for 4,000 people. It was a fascinating experience, but not something I wanted to do forever.

It's different being in someone else's culture rather than in a company whose culture you built.

You can create a culture you embrace and believe in when you start a company.

There is nothing wrong with Cisco's culture, and it works for Cisco, but it isn't the type of culture I could thrive in. The fact that it was at the peak of the bubble aggravated it because everything was about time to market, not about technology and investment in innovation.

SM: What did you do after Cisco? JE: I started a company called Packet Design in 2000. I was very concerned about innovation and how short term everything was after the bubble. Our idea was to look further out and do more research, including things that could fail. We would then have a portfolio of technologies and spin companies out that made sense.

SM: Was it an incubator model? JE: It was a technology incubator, and we were very focused on the networking market. But by the time we were ready to license or spin anything out, the networking market was gone. Of the three companies, one is a healthy private company called Packet Design Inc. One, Precision I/O, had phenomenal technology assets but never got off the ground, and it was shut down by the VCs, who lost patience. That was a humbling experience for me. The other one has been refinanced and changed its name, and I don't have anything to do with it.

SM: What knowledge and experience did you gain from your time at Packet Design? JE: For the first time I realized how hard it is to hire CEOs. One of the problems with an incubator is that if you try to turn the idea over to someone else, and it wasn't their idea, they may not have the same passion for it. It was also during that time that I realized how risk-averse the VCs had become. I would try to help the companies raise money, and VCs wanted customer names to validate the market. I would look at them and say that if the market could be validated, it was too late for a startup.

After 2004, I didn't want to start any more companies. I don't know if that was because I'd spent too many years starting them, or if the environment had changed too much, but I'd done that and I wanted to do something different. I became very concerned about the state of innovation in the Valley. I was also involved in a very public proxy fight while I was on the board of Disney.

> ***Seeing the Valley, the shareholder-activist, and Wall Street pressures on large companies, I felt the country was becoming more and more short-term focused. There was more and more push for incremental innovation, not the types of things we had built.***

At the same time, in 2004, I turned 50. Bill and I decided to split up, our son started high school, and I started thinking about the world he was going to go into. I realized it was going to be nothing like the environment that had allowed me such a phenomenal career. I started speaking on the subject, and after a year of presenting my thoughts on innovation, the problems we had, and what we needed to do about it, a number of people came to me and asked me to write a book.

I have never been a writer. I don't like to write, but I was at a time in my life where I was open to new things. I thought I should give it a try, and it was quite a journey. When I decided to write the book, I really wanted to go beyond just business innovation because I felt that the main purpose and message was that we had become too short-term focused and too risk averse. I also believe that businesses do not exist in a vacuum, and some of the forces that were creating

innovation in the country were actually coming from national policies and dynamics. I decided in writing the book that I would make it valuable to businesspeople, and I'd help them understand what it really takes to create environments of innovation. I also wanted to look at the national issues of different policies, investment in research, and education. The book itself lays out the problem and then lays out a framework for thinking about innovation. A lot of people think that innovation is a product, but in order to have sustainable innovation you need research, development, and application of science and technology. I have the notion of an innovation ecosystem, and I use it as a framework for people to think about innovation.

I talk about a set of core values you need for any innovative environment to exist, which are questioning, risk taking through an acceptance of failure, openness, patience, and trust. Questioning is not only curiosity, it is also self-assessment. Openness is not just imagination, but collaboration and incorporating others' ideas. During the lead-up to the bubble, we lost our patience. In the crash of the bubble and the corporate scandals that followed, we became risk averse and lost our tolerance for failure. The last eight years, just in terms of the leadership and how we reacted, we lost our questioning, our openness, our trust, and our willingness to self-assess. These values have to be in balance. If you have trust without questioning, that's blind faith. If leaders just tell their employees what to do, you will not get innovation.

SM: Really strong people do not tolerate that kind of dynamic. JE:

The way to lead innovation is to bring out the leadership in each individual.

If you have risk without questioning, openness, or trust, you have the economic crisis we have today. We have people taking risks, but not asking questions.

SM: Additionally, I think two other dynamics have led us here. One is the sense of gold digging, and the other is a sense of looting. It is rampant opportunism. JE: A biological ecosystem consists of organisms interacting with their environment. In an innovation ecosystem, the environment is leadership, funding, policy, education, and culture. The two most important are leadership and culture.

From a cultural perspective, we've come to value trading and flipping more than building and creating.

When people look at trickle-down economics today, the reason that notion does not work is because the people who made the most money back then were the people who created the most jobs. Today the people who make the most money are actually not creating jobs; they are getting rid of jobs.

SM: I am in complete agreement with you. I wrote a story called "Silver Lining in the Financial Crisis." There are 185,000 jobs in Wall Street in steady state. They are going to lose 45,000 jobs in the midst of this crisis. This is the best thing that can happen. All these young people who are rushing into finance without any consideration of other viewpoints or value systems are going to get turned off and scared. JE: Unfortunately, it is deep-seated in the culture. It will take at least a generation, and we all have to think as parents, mentors, and leaders, how do we affect this notion of instant gratification?

There are two types of leadership. People talk a lot about threat or competition being the motivating force for companies or countries, and they say we need another crisis. I don't agree. We've had plenty of crises. There are two ways we can motivate. One way, which is anti-innovation, is to take that threat and create fear in your employees or your country. That's what Bush did after 9/11. Or look at Sequoia's reaction to the economic crisis, their RIP PowerPoint, which created panic. That is anti-innovative and is poor leadership.

True leaders take that threat and turn it into a challenge, which they use to inspire and rally people. That turns on people's executive functions. They realize it's a challenge and an opportunity to invest. Instead of going to a portfolio company and asking them to cut 20%, you go to the boardroom and ask them, "How will this affect our market?"

SM: Where do you go from here? What is the game plan? JE: I have no idea. My book came out in September 2008. It's fairly broad. It has business connotations, it has implications for nonprofits, and it has policy recommendations. I probably won't do anything in the business world with it. I may get involved in nonprofits or policy-level opportunities. I still have my board seats, but I have purposefully not plotted where to go. The one disadvantage of being an entrepreneur is that it takes so much focus that you can become too focused.

Writing the book expanded my mind. The things I listen to on TV and the things I talk to people about are completely different now. Now the scope of things is at a much different level. I'm ready to engage in different things. I'm trying to get a message out.

SM: This has been wonderful, thank you.

Eric Benhamou

Beyond invitations from Steve Jobs to join Apple's board and from President Clinton to chair the President's Information Technology Advisory Committee, networking industry pioneer Eric Benhamou has also maintained a day job. The CEO of 3Com from September 1990 until December 31, 2000, he eventually moved on to become its chairman.

During his tenure 3Com acquired Palm, where Eric once again served as the CEO and later its chairman. Quite a story for someone who started out as a self-described "young punk."

SM: Eric, where were you born, and what kind of environment did you grow up in? What propelled you to where you are today? EB: I was born in a small village between Algeria and Morocco in the mid-1950s, a time when the whole region was going through wars. The Algerian War was breaking up at the time, and there was increasing tension between the Algerian population and the French. This forced all the Jewish population in the region to leave between the 1950s and the early 1960s. We were part of that massive exodus.

There were three destinations: Israel, France, and North America. Our family went to France, which is where I went to primary and high school. As I grew up in France, I felt moderately comfortable, but not terribly comfortable. Clearly I grew up in the French culture – French was my mother tongue – but as I became a teenager, I was no longer sure I wanted to live there.

SM: What was the driving factor? EB: There were two circumstances. First, being Jewish in France is not always fun. You don't feel welcome. More importantly, I felt that I had an entrepreneurial chord at a very young age. I wanted to start things. I was the one to start clubs, groups, and movements at school. I realized that this kind of attitude was not very welcome. France was not favorable to entrepreneurial thinking because there's a certain amount of irreverence in being an entrepreneur. You're saying you're not satisfied with the way things are, so you're going to do it better.

SM: The old "I'm going to do it my way" saying. EB: That's right. I even started a small business when I was 13. I had observed that where I grew up, in the town of Grenoble, there were quite a few abandoned bicycles and mopeds. I felt there was quite a bit of waste there, and I recognized there should be a business in recycling parts.

It didn't go very far – it turns out I was unable to mobilize enough discipline to create a real business out of it – and I ended up doing most of the work.

So I went through engineering school in France, but I resolved right away not to stop there but rather to get a piece of my education in the US. Like many people in my generation, I was fascinated with America in a positive way.

SM: What did you see in America at the time? EB: It was mostly the energy. I had no idea about American entrepreneurs, and I certainly had no idea about venture capitalism. I felt all the external sides of American culture exuded openness and energy; I felt comfortable with this mindset.

SM: I wonder how youth in different parts of the world view America today. When did you come to America? EB: When I finished my engineering school in France, I came to Stanford for graduate school. I only picked that school because one of my cousins had taught there a few years before and he raved about it, mostly because of the climate and the beautiful campus – but small things can make a big difference.

SM: Did you plan on studying engineering at Stanford? EB: I came to Stanford with the intention to learn about biomedical engineering – I was fascinated with applying technologies to medical ends, but it turned out when I got here something else became even more exciting. I got here in the mid-1970s, at a time when the microprocessor had just been invented, and networking had just been invented. Xerox PARC had just started sending Ethernet packets the year before. I realized that computers were getting smaller, cheaper, and more powerful. I was fascinated by this, so I shifted to computer science and electrical engineering. In the end, I decided not to finish my PhD, so I walked out with a second master's because I wanted to have work experience right away.

SM: Where did you go after Stanford? EB: The first company that offered me a job was Zilog. They were the second microprocessor company in Silicon Valley; Intel was the first. The inventor of the microprocessor, Federico Faggin, had left Intel and founded Zilog.

I joined him about 12 to 18 months after he started the company. There I learned about microprocessors straight from the inventor – it was absolutely terrific. At the same time, I had learned about networking from my visits to Xerox. Within a couple years, I found myself building more complex microprocessor systems, putting them on the network, just like the network at Xerox, except instead of using expensive machines I would use inexpensive Z80 microprocessors. We started building a network called Z-Net, built completely out of microprocessor technology in order to make it cheaper than the high-end Ethernet-based network they had other places.

We didn't have fancy graphics, but we had very good microprocessors. By 1978, we'd built an environment which is architecturally very similar to what we use every day now: personal workstations, shared printers, and servers all connected by a network, which provided services like e-mail and messaging. I was convinced networking was going to be a huge thing.

SM: But Zilog's focus was not on networking. EB: Right. We attempted to build a business out of the networking developments. When I say we, I say a few friends who all ended up being significant contributors to the networking industry. People like Judy Estrin, Joe Kennedy, Bill Carrico – the people who ended up starting all these great companies in the late 1970s and early 1980s.

We attempted to build a commercial networking business at Zilog, but we weren't given the green light, which discouraged the entrepreneurs among us. In 1979, Charlie Bass, who was my immediate boss, left Zilog and founded Ungermann-Bass with Ralph Ungermann. This was the first Silicon Valley networking startup. I was supposed to join him, except I had started my green card process and was told by my lawyer that I shouldn't change employment in the middle of the process.

So Ungermann-Bass got started, raised money, and unfortunately, I could not join them. It turned out to be a good thing because when my green card came through about 18 months later, I was able to co-found a company called Bridge Communications, which ended up being the

second networking company competing directly with Ungermann-Bass in the same general space. Our two companies were the networking pioneers.

SM: What was the industry landscape like then? Was it easy to raise venture capital? EB: There was a little bit, but it was not easy to find. The 1970s were not particularly dynamic for the economy in general. It was after the oil crisis of the late 1970s, but there was some excitement around computers and microprocessors. Of course the Internet was not known. We ended up raising money from Lawrence Weiss Peck and Phil Greer, and you know the history of that firm. Now it's Lightspeed Ventures. At the time we raised $1.8 million.

SM: A lot of money for the time. EB: It was an incredible amount of money for me. I had no idea you could raise this kind of money. It was enough to start our company, build our team, and develop our first product. I remember we got the go-ahead in the fall of 1981, and we closed a few days before Christmas of that year. We got started right away, and 1982 was a big development year. Christmas of 1982, exactly one year later, I was personally installing our first beta customer, UCLA. Basically, UCLA had wanted to network all of its computers, which were PDP 11 and VAXs.

They were considering Ungermann-Bass, but we got them excited about a new product that was substantially superior architecturally and performance-wise. The only condition was it absolutely had to work by the time the students got back after the Christmas break. That meant we had to fix all the key bugs in about two weeks while the students were gone. I spent that Christmas break there, and it was a very, very close call. The network was not bug-free, but it worked well enough that when the students got back in January, they had access to not one computer, but the entire network.

In those days, that was magic. Obviously, it enabled the departments to dramatically improve the utilization of its computer infrastructure. It also became a reference site, and we soon had many other installs. We bootstrapped the company in the engineering, scientific, and university communities as they were the early adopters of networking technology. Then, in 1985 we took Bridge public, and it was very successful. The company at the time had about $35 million in revenues.

SM: Enormous for the time! So were you running Bridge during the IPO? EB: The founding team was running the company, and the engineering areas were mine as that was my background.

SM: That was great for your very first venture – going public. EB: Yes, absolutely. In retrospect, it was a good time because we were able to ride a new market with perfect timing. Ungermann-Bass was founded perhaps a tad too early, because we could look at the architectural choices they had made and then do better. This was right at the time when microprocessors where transitioning from 8 bits to 16 bits. They chose 8 bits; we chose 16, which turned out so much better.

It turns out that a couple of years later, even though we were doing quite well as a public company, we became concerned that the market was starting to be big enough to attract serious players. Up until then it was just a few startups, but we began encountering substantial companies like Burroughs, Univac, and so on – even Prime Computers and Data General. The line was fairly blurred between computing and networking.

SM: Networking as a field did not exist before, so this was essentially the birth. EB: No, it didn't exist. Most people looked at it as a peripheral activity to computing, so anyone who was building computers could legitimately expect to be drawn into networking. We had an advantage: we weren't peddling any type of computer; we were building an open infrastructure for networking, so customers could connect any computer they wanted to this. They weren't married to any one type of system. This is significant because in those days it was fashionable to be proprietary. HP had their own technology, everyone had their own flavor of protocols, and we were Switzerland. We offered TCP/IP or Xerox open standards. As a result, we could create heterogeneous networks and keep freedom of choice for the customers.

Everything worked out great, except for one thing. At some point in the 1986–87 timeframe, our customers were telling us that they were buying these personal computers, and at first they were a toy, but ultimately they were going to use PCs instead of terminals. This meant we had to start connecting PCs to our network. We sort of knew how to do that, but our background was with bigger systems like mainframes. There was one company that knew how to connect PCs to networks, and that was 3Com. So we figured these guys connect PCs, and we connect mainframes, so together we can connect anything that matters.

SM: How big was 3Com at the time? EB: At the time they were 40%–50% bigger than us.

SM: Was the 3Com merger when Bob Metcalfe was running it? EB: Bill Krause – Metcalfe was CTO. We started some initial discussions. No one was forcing us to do anything, but everyone felt that it made sense. It was highly complementary, and there was only one thing that gave us some pause at Bridge. At the time, 3Com was behaving like a computer company, acting as if networking was an interesting thing you had to do, but that it was not their primary concern. They really seemed like they wanted to build computers and mainframes.

SM: So you were concerned that their vision was significantly different? EB: Exactly. We ended up combining with them, and we came together in a 45/55 combination in October of 1987. I still have the T-shirt – "Bridge and 3Com, an Unbelievable Combination." It became a substantial networking company of about $200 million, which was the largest at the time.

SM: That is a huge company for the time and the industry. EB: It turned out to be a difficult period because the merger proved to be very difficult to implement. The point that I mentioned before, that they had not figured out if they wanted to be a computer company or a networking company, came back to haunt us.

Bill Krause, 3Com's CEO, came out of HP and saw the world as computers and that networks were simply an interesting way of connecting computers. He saw 3Com revolving around computers and storage.

Through 1988 and 1989, the company went backwards. The fact that we had a divided strategy, where people had not bought into the same vision, combined with the fact that culturally the two companies proved to be very different, hampered progress.

3Com was a typical HP culture, fairly process oriented, form over function, detail oriented. Bridge was far more rough and entrepreneurial, really quick technology and substance trumped form.

We would show up at business reviews with handwritten slides, which had really good

content, while the 3Com counterpart would show up with PowerPoint. They were slick. It was well presented, but sometimes they had very weak content.

It was a definite clash of cultures. It turned out to be almost fatal to the company.

SM: How was that averted? EB: The board realized something needed to be done. In 1989, my two partners at Bridge, Bill Carrico and Judy Estrin, left out of frustration. We were no longer calling the strategy. We were part of the management team, but it was very frustrating trying to make progress. I decided to stay a few more months, and things kept deteriorating.

In 1990, out of frustration the board decided to make a change. They thought about bringing in an experienced CEO to take over the company, but in the end they asked if I wanted the job. I agreed to be the CEO for up to 10 years, even though I had never been a CEO before and I was not even 35.

This was a $300 million company. I knew the business was in crisis – we were losing money, our reputation was shaky, and the morale of the company was weak. We had strategic issues to fix, and of course we had restructuring to implement. We had to reenergize the company around a new mission. I was convinced we were not meant to be a computer company, and in those days, and it is still largely true today, you cannot be good at both computing and networking. It may be different in the future, but this has been true for over twenty years. You cannot be somewhere in the middle – you'll be poor at both.

SM: How did you begin to right the ship? EB: I decided to paint a vision of global data networks. I started describing how networks were going to connect all computing resources – it wasn't all going to be contained to a few universities, rather the world would be connected. I didn't use the term Internet because it didn't exist yet, but that's the vision I was describing. I called it a "global data network." My vision required very high-performance devices, dedicated, reliable routers and switches. At the time, we called them bridges versus switches. I was able to energize the company around the vision of being the primary suppliers of this infrastructure.

SM: In general, was the workforce at 3Com more aligned with your vision than Krause's? EB: It was a split workforce. We had some computer experts, and we had some networking experts. But we chose to build upon our roots at Bridge. This is what we would've done if we hadn't been interrupted and distracted by the 3Com transaction.

In 1990, after validating that this was the direction I wanted to take, we ended up restructuring the company. Of course, we had lost time. We had to reengineer our entire networking product line and attempt to leapfrog the current industry.

I knew we were going to have to go through two years of hell before we could get traction; it was a complete restart of the company. I called it crossing the desert.

I didn't want to mislead employees – I knew it would be tough, and there was no guarantee we would make it – but if we did we would have fun, make a big impact, and be rich. I had a slide in my presentation that had a picture of a desert and an oasis way in the distance. I said, "This is where we're going." Those who ended up staying were those who were hardcore, those who believed in the vision.

SM: While crossing the desert, what were some of the points where you felt this turnaround was going to work? EB: There were two pivotal points. After announcing the restructuring, we reduced close to 15% of our people. Somehow I felt a sense of relief because of the type of folks who stayed. We were no longer dealing with the past. We had some legacy customer situations to deal with, but we roped them off on a separate building on our campus. The rest of the company was dedicated to restarting.

The second pivotal moment was when a second generation of products started to work in the lab. When you build a chip you do all the models and simulations you can, but you just pray it works when it comes back from the foundry. You can handle a few bugs, but not a re-architecture of the system. When that happens it sets you back months or years, and we didn't feel we had such slack in the schedule. In mid-1992, the chips came back and they worked, they passed packets.

In the fall of 1992, we launched our products at a trade show, and there was a buzz in the industry. We had the fastest routers on the floor. We were routing the traffic at the show. We even changed the logo of the company to signal this was 3Com the networking company. It was very exciting when customers started to show up at our booth.

SM: One question about your managing the board during that difficult period. What did you learn from that process, and how did the board react – positively, negatively, especially looking back today? EB: It was very gutsy on the part of the board to ask me to take the lead on this company. I had never done this before.

I was just a young punk who understood how networks worked. They basically bet on a technologist to lead this troubled company.

SM: Who was the person on the board who made that decision? EB: It was Jim Barksdale. He was on our board at Bridge, and he carried over to 3Com. When the board came to the conclusion they should have a CEO change, he advocated that I be selected. He's been a great friend for decades now, but at the time Jim had immense common sense, and he realized that this industry for many years would be technology driven.

Of course, the board had to play this out. I made a few mistakes between 1990 and 1992. For example, in my first earnings call I said I wasn't sure what our earnings would be, but if I were you I'd be very cautious. With that first earnings call, we lost 20% market value. Nobody told me you should never say "cautious" when doing earnings calls, which is a signal that we had absolutely no idea what we were doing. This was a public company.

SM: Your background was in building things; Wall Street is about day trading, so it is a completely different psyche. There are people trying to drop the share price and pick up on the rise. EB: I didn't realize how sensitive a stock price could be in response to the words a CEO chooses and how he says them. I was much more positive on my second call.

The true company restart was 1992. We started growing revenues then on the strengths of new products. We became profitable again, and it's been a fascinating ride since. The company grew about 15-fold in a decade, in terms of revenues.

SM: That was the golden age of networking! EB: Yes, and shareholder value went from the million to billion range. It was fun – we felt our products were being used by all kinds of

people all over the world to make fundamental changes. They were strategic instruments of change across all countries and industries. This was before the world discovered the Internet.

SM: Cisco was also building itself during this timeframe, and you guys were going head-to-head. What were some of the key points of that competition, and what are the things they did right and wrong? EB: It wasn't yet a duopoly of Cisco and 3Com, but it became that in the second half of the 1990s. In the early 1990s, it was a broad field of play – lots of companies. It narrowed down to four in 1994: us, Cisco, SynOptics/Wellfeet (which formed Bay Networks), and Cabletron. These companies pulled ahead of the others, who were absorbed.

We were the first to realize the market was going to grow faster than any one of our abilities to follow it, unless we made acquisitions. As such we were the first to make acquisitions. My first was a bold one because it wasn't in Silicon Valley. I acquired a company in Europe, in part because we didn't have the currency to buy a Valley company, but also because I wanted to create a global business. It isn't enough to have a few sales offices overseas; you need to have a presence there, to build products, to have a source of market inputs. We bought BICC Data Networks at the end of 1992, at the same time we were launching new router products.

SM: What prompted that acquisition? EB: They had hubs. Hubs were basically how networks were implemented locally around structured wiring. Ethernet started off as a yellow cable that snaked across ceilings and floors, and then it became a twisted pair. You needed to have a hub and structured wiring systems similar to the local phone wiring, and we didn't have this capability.

When you build repeaters, which are the electrical function of hubs, you need expertise – they had that expertise. With them on board, we could compete with SynOptics. We were the first to envision that networks had to be built out of a few core building blocks, including switches, hubs, routers, and communication servers. You also needed some network management tools in order to manage it all. For the better part of the 1990s, I had to explain to our investors that these were the core building blocks of networks and that you needed them to build *any* network. We were the first ones to have all of those in-house through acquisitions. Cisco was only about routers. This gave us a positioning lead because we could solve overall networking problems.

SM: Did the market understand your positioning as an integrated networking solution? EB: I think they did. Of course, we were coming from behind in routers, and we were behind SynOptics in hubs, but we started to strengthen our position in all our segments, and this helped because we then had synergy. Turns out if you could make a network work, even if you didn't have the best products in all the categories, then you were the solution of choice. The fact is the industry was unfolding as a global data network industry according to our vision, and that really helped us and allowed us to pull ahead.

SynOptics was only a hub company, and they realized they needed a router piece to compete, so they merged to create Bay. And Cisco had to do something to not be pigeon-holed as a router company, so they bought a switching company.

SM: They all followed the 3Com strategy? EB: Yes, and Cabletron did the same thing on the East Coast. These four companies pulled ahead because they played the global data networking game, but it was 3Com that had the vision. Throughout the 1990s we held the intellectual leadership of the industry; all of the key trends came out of our work, in terms of the

transition of hubbing and the invention of switching.

During the better part of the 1990s, we were growing faster than anyone else, with a more diversified customer base, geographically and demographically.

SM: Is this when you began to close the gap on Cisco? EB: There was one play we used which enabled us to close in on Cisco, and we called it boundary routing.

Cisco was driven to more complex solutions than us. They positioned routing as something of a magic art, very complicated, and it was disempowering for the customer. Their positioning was "Mr. Customer, this is complex stuff. We are going to take care of it for you, but trust us, you need this big expensive box." It was almost a play from the mainframe days.

We had the opposite view – networking can be complicated, but you can easily contain complexities if you have a sound architecture. You should have products that are as simple as possible so you can keep control of your network.

It was more mass appeal as opposed to black art. We had credibility there because we had the best network PC connections in the world; we were by far the market share leaders, and our products were plug-and-play. The average network users did not really know what we did in the bowels of the network, they only knew they had a 3Com card inside their PC, and this card that never failed is what gave them access to the network. It was super easy to install, and this was essentially our external face to the customers.

This gave us great positioning, and we then invented boundary routing, which really gave us an edge. Imagine a large network, such as a bank, with headquarters in one place and branches throughout the country. You create a network throughout the bank, where the typical routers are inside the branches. These routers are at the edge of the network. In the core of the network, you have complexity. Packets have multiple paths to choose from, so the routers have a lot of real-time decisions to make. When you're at the edge of the network, that router does not have a lot of choices. The router sees all of the packets that go by on the local branch, and any packet whose address is not local has to go to the center. We called this a boundary router. It was very simple. It didn't have to have all of the complex Cisco protocols, just a simple boundary router, and it's one-tenth the price of a regular router.

This was very threatening to Cisco. Matt Howard was the product marketing director for routers at Cisco, and he was scared. They had no answer to this. Their whole business was selling expensive routers, and if all of a sudden the edge routers became simple and cheap, they would lose tremendous edge.

SM: So what prevented you from finally catching Cisco and passing them? EB: In 1997, there was one major shock for 3Com. More and more enterprise networks had to extend into carrier networks. Enterprises couldn't build all of these large intranets themselves; they couldn't manage the WAN. They had to use the carrier networks to switch their packets. You couldn't build enterprise networks successfully and sell to the enterprise unless you could sell through carriers and into carriers.

There was one big trend: the growing presence of carriers in data networks. Until then, they were only switching voice, but now they were switching data and selling data network extensions.

Then there was Mosaic, Netscape, and the Internet – networking started touching the masses. It became a mass market, a consumer market.

I became convinced the kind of network we built had to be deployed in small businesses and homes. Everywhere, with an enterprise base, we were pulled towards carriers on one side and

consumers on the other. At the end of 1996, it was probably the peak of the company in terms of its flawless execution, but we had a choice to make.

We almost bought a carrier company on the East Coast, but at the last minute a couple of my executives and board members felt that company was too expensive. They were trading at huge multiples, and even though it made sense strategically, we could not justify the price they commanded. So we decided to pass on the buyout even though we were pretty far along, and we decided to go with a second choice, which was US Robotics.

SM: What was the appeal with US Robotics? EB: They had the advantage of helping us address two things at once. They had a consumer play, selling through retail channels to consumers, and they had this business called Palm. They also had a carrier play. In those days, the only way you could access America Online was through dial-up, and the only dial-up line switches were US Robotics, both on the consumer side and on the infrastructure side. This was attractive, and it was more palatable price-wise to the board because we addressed two concerns at the same time.

It was a $6.5 billion transaction, and 3Com was at $35 billion. This happened in January of 1997, and we closed in May of 1997. Ultimately, it became a huge management challenge because complexity more than doubled. We had a massive influx of new channels to deal with, new business models. Retail channels, carrier channels, and we now had the Internet as a channel – we more than doubled the number of products offered, and we had branding considerations, both consumer and carrier, and then we had to deal with locations. US Robotics was based in Chicago and had locations all over the world, just not where we had locations.

It became complicated, and US Robotics was at an inflection point where modems, which comprised a large part of their business, had steadily increased in speed. They were about to go to the next increment in speed, which was 56K. Up to that point, they had been able to ride that incremental increase beautifully. But for 56K, the industry fractured.

It happened just when we were closing the transaction. The industry failed to come to an agreement on a common standard for 56K. Consumers didn't want to buy the wrong thing, so they decided to sit back and wait for the dust to settle before they upgraded to the next modem.

This was also true of the infrastructure players since AOL wouldn't upgrade unless the consumers asked for it. Then, people started talking about broadband – why upgrade if you can go to DSL or cable? This created a big implosion. During the second half of 1997 and 1998, 3Com really lost ground because USR started to shrink.

SM: Were there any positives to come out of this mess? EB: The only thing that came out different was Palm. Palm had been set aside because I felt it was a very interesting business, potentially a category maker. I let them run as an autonomous subsidiary, and I didn't ask them to contribute to the bottom line of the company.

It was a big investment because other divisions were struggling. But I let them invest in their business, and I didn't ask them to participate in the same processes as the rest of the divisions – I didn't want to integrate them tightly.

Fortunately that bet worked, because we were able to really substantially grow the business and create a category called handheld computers, which partially made up for some of the shortfalls we had in the US Robotics businesses.

SM: Large acquisitions are often very challenging to deal with, even if they make

complete sense on paper. EB: That period, 1998–1999, was a very difficult one. Cisco hadn't made such big bets. They made smaller acquisitions and were able to pull ahead. We had almost closed the gap in 1997; they were at $5.6 billon, and we were at $5.4 billion. Two years later they pulled ahead substantially.

This brings us to 1999 – Palm had become a substantial business, approaching $500 million in size; when we bought them, they were at $20 million. Right after we bought USR, the ink wasn't even dry on the agreement, the two founders of Palm, Jeff Hawkins and Donna Dubinski, were in my office explaining why I shouldn't buy Palm, that I should just spin it out. They preferred to be autonomous.

I listened and told them that I bought USR in part because of the Palm business, and that we weren't going to use a coercive management style, and that they would have a lot of autonomy to build a new category of product. Also, we paid a lot of money for the business, so I wasn't going to just let it go, and beyond that I wanted them to help build shareholder value.

This was the start of the conversation in 1997. In 1998, I was up to my eyeballs in problems with the rest of the USR business, so I had no patience to envision a separation of Palm. I couldn't even seriously consider it – in those days when companies combined and pooled assets, if you wanted to preserve the tax-free nature of the transaction, you were supposed to keep the pieces together for a couple years. If you bought a company through pooling and then sold a piece of it, you had tax liability.

> ***We couldn't afford to have the entrepreneurial aspirations of a few people expose us to a multibillion-dollar tax bill.***

So they left and formed Handspring in 1998, convinced I was serious about not spinning off Palm.

At the time they left, I felt good about it – I didn't think they were going to be serious players inside the company. They would help themselves, but not me. When you go through a fickle situation, you have to find out who's on the boat with you rowing – they were not rowing on my account.

SM: I think you find that a lot with folks who are entrepreneurial by nature – they like to be in charge of their creations. When did you ultimately spin off Palm as a separate company? EB: By 1999, things had changed. Enough time had gone by that technically I had the option to spin off a piece of the business without incurring a tax penalty.

Second, Palm was no longer a fledgling company. And thirdly, I had been able to inject management talent into the business so it could stand on its own. Because we'd done some integration with a few pieces of 3Com, we were able to get economies of scale and improve the profitability of the business.

Finally, the market as a whole recognized this was an emerging category and it was no longer a toy. There were analysts covering it, and it could gain valuation. I was then convinced the best way to leverage value was outside 3Com because we were putting a lot into Palm, but not getting much in return.

SM: And you were not getting much valuation out of it either, were you? EB: No, we were getting some conglomeration discounts, but that's all. The only way to monetize the value was to spin it out. Particularly at a time when there was inflation in valuations and investors were

drawn to pure plays with high growth.

We felt we could get a premium if investors could look at this business as a separate entity. Fortunately, we had kept the brand and structure separate, with its own sales force, so we had the option to do that.

In the summer of 1999, I started to think about this very seriously, and I asked Goldman Sachs to do a study for me, which convinced me we could do it. In September 1999, after Labor Day weekend, I called a board meeting and asked my board to support the spin-off of Palm. Everyone felt comfortable that it was the right time and the right thing to do, so we set things in motion.

SM: Was there any competition in this area? You mentioned Donna and Jeff had left to form another company. EB: As it turns out, Donna and Jeff, who had formed Handspring the year before, had asked me for a license of the operating system to build their own Handspring product. They came to brief me, and their products were basically a clone of Palm, using our operating system. They were going to launch on September 10, the same date we'd chosen to announce our intention to spin off Palm. We'd reached this decision independently – it happened to be a national conference – but I couldn't tell Donna and Jeff about it. They couldn't be insiders because they weren't employees of the company.

When the day arrived, they had their press conference, and we had our own to announce the spin-off of Palm, which completely dwarfed the Handspring launch. I felt bad because we took the limelight away, but that's how it happens.

SM: You were the CEO for how long after 1999? EB: Until the end of 2000.

SM: What prompted you to step aside as CEO – your commitment to the 10-year timeframe? EB: Yes, I had completed my 10 years as CEO. I wanted to make sure I turned over a company that had attained the valuation of Palm that we wanted.

However, there was one other decision I made at the time, which I now regret. After the Palm spin-off, our enterprise networking business had lost momentum over the previous two years, and the high-end segment became unprofitable – at least on paper.

My business development team analyzed it and came to the conclusion that this segment of the business was unprofitable. My board was of the view that we shouldn't be in unprofitable businesses – either turn it around and show profit, or get out. I didn't have a short-term plan to turn it profitable because it's so expensive to sell into the enterprise. But I did feel that it was the wrong way to look at it because these businesses are so interconnected – more so than the analysis was showing.

I felt the analysis failed to capture the trickle-down effect. If you get into the high-end market, lots of good things happen because your products are adopted by powerful companies, and you don't have to work as hard for the mid-range and low-end products. But it's hard to capture that phenomenon the way the analysts report the numbers, and my own controllers reported the numbers the same way. I couldn't show it, and I couldn't explain the potential relationship damage it would cause if we pulled out of the high end.

Perhaps I was mentally tired at the time, but I gave up too easily. The board was asking legitimate questions, but they were coming to an answer too quickly, without understanding the nature of the business. At the time, I ended up saying, "Well, you must be right after all. We're not making money, so we should pull out."

[SM: Readers looking for answers to the mysterious question of what went wrong at 3Com – how such a powerhouse shrank over the course of the next seven years – may note that this was the fatal decision for the company. The high-end market became Cisco's stomping ground, and later it became near impossible for any other networking company to enter the enterprise, earning the networking industry the moniker "Cisco and the Seven Dwarfs."]

SM: Whom did you sell the high-end product line to? EB: We sold it to Extreme. We put Extreme in business.

It was a bad decision because the analysis was wrong. It was taken in an overheated period by an over-impatient board who were comparing 3Com with companies whose growth rate was inflated and artificial. We were comparing ourselves to companies who, on paper, were selling lots of products, but in reality the products were just going into warehouses.

It was 2000, the peak of the bubble, and we were holding ourselves to a yardstick that we weren't using to measure others.

Looking back, we were profitable when others were not. It was a bad analysis, conducted too quickly, approved too conveniently. The company was flush because of the successful Palm IPO, so we felt comfortable. We didn't appreciate the parts of the business which were hard to measure. There is a great quote by Albert Einstein that says, "Not everything that can be counted counts, and not everything which counts can be counted." That sums up the situation.

What counted most were the relationships with the large customers, good products, and that the customers were happy. We could measure the dollars and cents when we sold a high-end switch, but that was the wrong thing to focus on because in total it was a good business, an integrated business.

This was the only decision in my tenure that I really feel bad about. I don't blame my board for this. Ultimately, it's the CEO who is accountable. I should have just had a good night's sleep, called back the board, and told them it didn't feel right.

Throughout my tenure I had listened to my gut more than analysis, and the one time I didn't, it proved to be a really bad decision.

SM: What have you witnessed as a chairman since then? What lost 3Com the position you were in at the end of the twentieth century? EB: I honestly believe it was just one bad decision. I don't think it's fatal, but it was clearly a bad decision, which set us back.

In addition, the restructuring that was done afterwards was too reliant on a paper analysis; once again, the spreadsheet jocks were running the company as opposed to those who have a feel for the business. We let the wrong people go – the people who understood how to build great networks, develop algorithms, and build elegant architectures.

SM: Did they leave because they had made too much money? EB: We didn't send them the right signals. We essentially told them the bottom line was what mattered now, and you had a sense the place was no longer run by the same norms.

That happens often when you have CEO transitions. Bruce had a very different style from mine. Mostly, he didn't value the same things as me. When I walked down the hallway and came across a great engineer who created really brilliant things, I spent time with him. Bruce couldn't care less. He couldn't detect that type of engineer. That was the difference.

If I could summarize the core skills 3Com had from inception, it would have to be said that 3Com had great engineers and the best products in the industry. To this day we have the largest patent portfolio in the networking industry because of our core mass of technologists. On the other hand, Cisco had a great sales force, the best in the industry.

SM: 3Com has done precious little with that brilliant patent portfolio – and Cisco also did a very good job with acquisitions. They acquired small companies early, integrated them well, and put them in the channel. EB: We did this as well. We acquired 25 companies and integrated them very well. We acquired one large one that perhaps we shouldn't have, but the rest were in the same style as Cisco, and we started this very early.

> ***What ultimately hurt us was losing what made us successful. We didn't have the craving to innovate and do things better anymore. When we lost that, we lost. Steve Jobs calls it the hunger to make insanely great products.***

We had that, but we don't have it today.

SM: So – Palm. You spun Palm out in 2000. What happened from that point, in terms of valuation and industry dynamics? What did you find waiting for you on the other end? EB: This all occurred at the peak of irrational exuberance. This was when NASDAQ went from 4,000 to 5,000 in a couple of months. In fact, when we did the road show in February of 2000, NASDAQ was flirting with 5,000 – it was near record level.

We increased the filing range multiple times, and when it came time to price the deal, it was clear that we had the opportunity to price it at the very high end of the highest range we'd filed at. It was a bit of an acyclic business challenge because anyone who had their feet on the ground knew the market had gone totally crazy and that they shouldn't be overly confident. We had a good business, but we didn't have that good of a business, or the slush money, to warrant the price of our options.

However, when it comes down to it, as a public company CEO you're there to maximize the value of each share. It doesn't matter whether the buyers are sensible or not. So we spent considerable time discussing the trade-offs between pricing reasonably and pricing aggressively, and we decided to go aggressive. We opened at $32 and closed at $100. When we finished our first day of trading, Palm was worth more than Ford and General Motors combined, which was totally incredible.

SM: You mean ridiculous! Your revenue at the time was $500 million, right? EB: I believe we were between $500 million and $1 billion. The company was profitable, unlike some of the other dot-coms that couldn't make profits. Palm offered a real, tangible business where people were buying the products. Clearly, the valuation was unheard of. We knew this was a mixed blessing.

SM: It's hard to sustain that kind of price range… EB: We knew the price had to come down, but we didn't exactly know how it would come down. We also saw how history unfolded in terms of the crash. It turns out that we started trading on March 1, 2000, and I think NASDAQ had already passed 5,000 and was within 48 hours of its all-time record. Had I wanted to time it better for our shareholders, I don't think I could have come closer.

Clearly, shareholders enjoyed a tremendous return. It turns out we didn't float as much of the company as we could have. In a two-step spin, you have to retain at least 80% of the shares you own and distribute them as a dividend. If you don't, then you don't benefit from the tax-free treatment.

SM: Did 3Com retain 80%? EB: It turns out we retained more than 90%. It was not like Palm needed cash; it was already profitable and cash flow positive. It received a big injection of cash even with the small amount of shares we floated.

SM: Very similar to what is happening with VMWare and EMC. EB: The valuation is probably a little more warranted with VMWare. It's close to $20 billion, but it's a real business which has aged and stood the test of time, and I don't think it's the same quality of business as most. It has a deeper, better quality of revenue.

At the time we felt we had done the best we could do for shareholders, and it remains the most shareholder value creation I have ever achieved in my career. But I also knew there were some unintended consequences. When you bring a public company to market that hasn't aged sufficiently, and which has a management team lacking maturity and being paid with options priced at a very high strike price, you don't get a very good mix. In fact, you're in a very difficult situation because when the downturn comes, and it inevitably comes, you don't have a management team with the seasoning to withstand it. Suddenly their options are underwater, so you don't have the incentive power to retain them. It was a bad situation. Most people only realized this a few months later.

SM: When did you feel the pain of the crash? EB: It was almost a year later.

After a year of relative stability, Palm faced the market crash concurrently with a failed product launch. The combination of stock market problems and operational failure created a bad situation, which was compounded by a lack of innovation in product development.

SM: Did the stock price sustain for a bit? The market started going bonkers sometime in April 2000. EB: It wasn't until 2001 that the markets really started slowing down. Throughout 2000, there was momentum which carried the company forward, and while the share price dropped some, it was still trading in the $50s, which was an incredibly high multiple.

Our biggest hit occurred when Palm missed a new product introduction. Are you familiar with the phrase "Osborne," as in when a company "Osbornes" itself? This happens when a company announces a product that makes their own current product obsolete, but at the same time it's unable to deliver the new product. It basically ends the sales of the current product because customers are waiting for the new product, but the new product never reaches the market. It renders the existing product worthless, and it also creates the problem of missing sales quotas as long as new demand cannot be met.

Imagine what would happen to Apple if the iPhone were replacing an existing product, and Steve Jobs had announced in January they were only delivering limited quantities in June! We had a bit of that situation when we released a new generation of slim Palm V look-alikes. It was called the M500 series. It featured a very focused form factor, and it was the first really full-color device. In April of 2001, the product had glitches at the last minute, after we'd already introduced it, and these glitches made it so that we couldn't ship it. The management team totally dropped the ball.

SM: What was the management team at that point? EB: I had put in place a CEO, Carl Yankowski. In fact, I had introduced him before the IPO. I wanted the new management team to lead the road show and be in front of investors. They'd been in place a few weeks prior to taking the company public, and Carl basically ran the company through the 2000 timeframe and into early 2001.

These operational problems happened a year after the IPO. This is also when things started to go bad for the company. Not only was there stock market turmoil, but there were operational problems as well. The Palm V was spectacularly successful. It had a nice profile and form factor, and it worked great. The 500 and 505 were nothing more than modest evolutions – they never should've encountered the problems they did.

It was an indication that the management team did not have the experience required to manage a company of that size, where tolerance for errors was very, very small.

From that point in 2001, things went from bad to worse. The end market was not there to support continuous growth. The product was eventually delivered, but it wasn't a breakthrough product, it was simply evolutionary. There was no reason for satisfied customers to throw away the Palm V to buy this.

SM: Do you think it created market confusion for customers? EB: Yes. It was a sign that the pace of innovation had slowed down. All the people we'd put in place in senior management slots, and the new folks we'd hired leading up to the IPO, were not producing what they were supposed to. They were supposed to inject new innovation, create new markets for Palm to go after. We were particularly focused on wireless; we weren't using the word "smartphone" yet, but we were thinking about wireless capability and wireless access.

When we introduced Palm VII, which was the first wireless product, it was not terribly elegant. It used the paging network, so you couldn't do anything very advanced; you couldn't access the Web. You could get e-mail, and you could look up things: flight information, weather, and stocks – things like that. It could've been a promising beginning, but because the company had other things to worry about in its main business area, this wireless line was not pursued with the vigor it needed. Towards the end of 2001, in October and November, the board came to the conclusion that the management team was not going to be able to turn around this business in an acceptable timeframe.

So my colleagues on the board asked me to reengage as interim CEO, but I was uncomfortable doing that because it's never good to go back into a company you once ran. However, it was a difficult time, and we had relatively few options. We didn't want to try our chances with a first-time CEO.

SM: So the option was you! EB: Yes, I found myself as the CEO of a public company again in 2001. This was when I focused on turning Palm around. I recruited Todd Bradley to be the COO; he came out of Gateway, and before that GE. He was a very pragmatic, down-to-earth, get-it-done kind of executive. We worked well together. I gave him a lot of latitude to run the company on a day-to-day basis and helped him recruit some new people.

All of a sudden the company changed its tempo, and the culture became much more down to earth; it developed a nose-to-the-grindstone, let's-get-it-done-on-time mentality.

After a few quarters we had regained profitability, expanded gross margins, and increased top-line growth. It took a long time because we were pushing uphill; the market was no longer in massive expansion. And the brand was a bit stained because we had stumbled with a previous

product release. But during that time, we learned how to build derivative products without taking too many risks. We learned how to manage the supply chain better, and we regained operational credibility and self-confidence. As we headed towards the end of 2003, we decided to make a big bet, to re-launch an aggressive wireless initiative.

SM: Is this when the smartphone play began? EB: Yes. Initially, we made a smartphone product on the drawing board. Eventually, we decided that since Handspring had also stumbled in a bad way, and since they were running out of cash, we had enough of a cushion to pull ourselves together and acquire smartphone technology from Handspring.

SM: Was Handspring's focus at the time the smartphone? EB: Almost entirely. They had already started their smartphone product; they were a few months ahead of us. So we started seriously exploring the possibility of acquiring Handspring, which we eventually did in November of 2003. This was a difficult decision to make because it was led by Jeff and Donna, who had competed against Palm directly. So we were basically buying a competitor, but not for the handheld – that was yesterday's game.

SM: You were buying Jeff and Donna again! Was there a lot of vision overlap between Palm and Handspring at the time of the acquisition? EB: Yes, this meant that essentially we were buying them back to have access to the smartphone product, which was the Treo. The first Treo was an interesting product, but not a great one. It was the Treo 600, which hadn't been launched yet, that we wanted. In our opinion, it had great promise.

SM: In terms of pricing, did you get a discount because Handspring was in trouble? EB: No, I wouldn't say we got a discount. I think we paid a fair price. Even though Handspring probably didn't have that many options left, I think we paid a fair price in part because we wanted the team that we were acquiring from Handspring to feel that they were rejoining Palm with credibility, not because they'd been squeezed out of options or had backed themselves into a corner.

There was a question of dignity that we had to manage; we were planting the seeds for a more effective integration.

It was still a difficult thing to negotiate. When you have former founders who come back into the company, but who do not come back as CEOs or top-level executives, it's difficult. Jeff didn't really reengage as a full-time employee. He became chief scientist, but not on a full-time basis. And Donna didn't engage in a management slot at all, electing to remain as a board member. Nevertheless, we had to integrate management teams and boards just like we had to integrate the two organizations at rank-and-file levels.

SM: How did you handle the issue of CEO? EB: This was a time when I thought Todd had demonstrated his worth and should become the CEO, leading the combined company. I went back to my chairman role, and Todd was promoted to CEO. He oversaw the integration of Handspring, which I think by and large was quite successful. We had relatively few casualties; we held on to the key talent. We introduced the Treo 600, which was a good product, the leader in its category, and we followed it with the 650.

SM: I think operationally you managed to turn the company around, but where was the marketing vision coming from? Who was the visionary? EB: We still had Jeff, who had envisioned the Treo. It was his brainchild, just like the initial PalmPilot. He was injecting all of the visionary thinking, but he wasn't doing it with the same intensity as he had in the past. He had other things to do as well; he and Donna had started a brain research company on the side.

What we found was that there was still a cultural mismatch between the Handspring team and the Palm team. Palm had become a very businesslike company, closer to Dell in culture. Handspring was closer to Apple in culture. In fact, the culture of Apple as a startup – they really focused on product ideas and creativity. Meanwhile, we were confronted with the task of having to satisfy not only consumers, but also carriers, who were the only real channel to consumers. When you're in the smartphone business, you don't sell your phones through Best Buy; you sell them through AT&T, Orange, and so on. You must go through the carrier machine, and you must meet all their requirements.

This requires a lot of discipline. Palm was struggling to find a balance between these two cultures – operational discipline versus a creative, innovative mentality. Todd was struggling to integrate the two as CEO. Ultimately, he left and found a great job at HP, where he's been extremely successful, demonstrating he truly is a world-class executive.

From there, we gave the reigns to Ed Colligan, the third founder of Palm.

SM: What is Ed Colligan's area of expertise? EB: He contributed a lot on the marketing front of the company. That was his main contribution. Ed was a first-time CEO. But the board felt he could preserve the innovation skills that had characterized the success of the early Palm days, while at the same time providing the operational focus.

The company didn't do very well after this transition, but not because Ed was a bad leader – he had very good leadership skills. Rather, the company suffered from what I call the "3M syndrome." They were so concerned making sure the Treo 650 and subsequent products would be reliable, that they would have an acceptable return rate, and so on, that it became the sole focus of the company. We attracted people who we thought could deliver these skills, and much like at 3M, when they got their GE-trained CEO, a lot of the creativity suffered.

SM: Productivity was good, but innovation was poor. Difficult tension to resolve! EB: From the end of 2005 through 2007, there was an intense focus on program management; a lot of derivative products were created. We added carriers and continued to grow rapidly. But the difference was that the smartphone market was no longer a brand-new market. It had competitors. Even though we were filling out the line, we weren't filling it out with great, breakthrough products, and competitors were closing in. We were growing revenues, but margin started to come under attack.

Companies like RIM kept executing extremely well; they were introducing more products and increasing their attractive form factors much faster than us. And we didn't think we could continue to support these margins because we had to invest more in innovation. Even though we were a $1.5 billion company, we didn't have enough critical mass to pour into innovation.

I would characterize this period as sort of wading through. There was growth, and it was generating cash, and we certainly had good market share, but we were by no means breaking out.

SM: You were losing market position at this point. Did you ever consider selling to Apple? EB: There might have been an opportunity to do that before the iTunes/iPod product

division was too far along, but I don't think this became a real opportunity in the timeframe that would've interested us. Had we not turned around the business in 2002–2003, Apple would have certainly looked at it closely, and they would have jump-started their efforts into this form factor. However, we would've been selling at the bottom of the market, a company in decline that was losing market share. After turning around the business, we created new value for Palm, but as a side effect we lost a potential acquirer.

SM: Once you had revived Palm, what was your next step? EB: We became very interested in exploring all of our options at the end of 2006. At that time, it was clear we had to paddle faster; we didn't have enough resources to move into the next generation. Our team didn't have a lot of superstars. We had some good journeymen, but no superstars. This was not the type of team that was going to carry us into the big leagues.

For a company that was growing profitably in a hot market, we had one of the lowest multiples, which is to say that compared to peer companies, we were suffering steep discounts in terms of market value given to us by investors. The lack of critical mass, not providing new breakthrough products, it had all become more and more visible. It was pretty clear if you looked at the Treo 680 and compared it to the Treo 650, they were very similar products. It no longer had the protruding antenna, and it had a bit different form factor, but from the user perspective it was the same product.

SM: The big opportunity that I felt Palm missed out on was on the software side. There was a huge opportunity for enterprise integration. RIM was very good with e-mail, but that was it – they didn't push it any further. Palm had good implementation of the Windows OS, and they could have gone in that direction, becoming more of an enterprise player, but that did not really happen. EB: It was not a failure to acknowledge the opportunity; it was a failure to execute. The task of meeting operational demands by carriers became all-consuming. The carriers didn't leave the company with enough bandwidth or energy to go off and start playing with serious business expansion issues. One was to grow and become a credible supplier to the enterprise. We pursued that by offering the Windows version of Palm that could get past CIO checkpoints because we had the correct operating system from their perspective.

The other opportunity where we under-executed was in services. We felt that once a customer had committed to a Treo product, the customer would be receptive to buying services, thus enhancing the revenue stream for the company while enhancing the consumer's experience with the product. This is not unlike a Macintosh user. They subscribe to a Mac service, which gives them basic services to enhance their experience. It was a direct equivalent for a Treo user, but it took us a very, very long time to get this off the ground.

SM: That aspect was also marketed poorly. EB: I will not disagree with that. In the spring of 2007, we finally introduced the Palm service, which gives you a basic backup and recovery archival capability. Even today I think it's still in beta.

SM: So services is a key strategic initiative, and you think it's still in beta! EB: Well, this was a core opportunity. In the spring of 2005, at an annual strategy board meeting, it was decided that a key goal for the company would be in the subscription area. We had failed to execute on this. And it was taking a toll. So we began seriously looking at all of the options available to the company. Eventually, we ended up focusing on one that's currently being put to a vote, which is a

sort of partial privatization, free capitalization of the company with the private equity firm Elevation Partners.

Elevation has really smart partners who understand this business very well. These are folks like Fred Anderson. Folks who come out of the industry and who have understood the Palm business for quite some time. They know that with operational execution and the injection of innovative talent, the company could do far better.

We came to an agreement that they would take a very substantial stake in the company and get involved at the board level. Fred Anderson, who was the CFO of Apple – and let me emphasize that he was a broad-scope CFO during the turnaround of Apple – will join the board. Basically, Fred is someone who managed to get Apple to deliver on its earnings stream and commitments.

SM: What about the CEO, though? EB: What was critical was to be able to add this talent around the CEO – that it would be compatible. We were nervous about this, and it took a lot of assessing of a team comprising Jonathan Rubinstein and Ed Colligan. Ed is the most sanguine about this opportunity. He convinced the board that he would make it work and that he had found the right partner in Rubinstein – an individual with complementary skills. He felt the social issues and board issues were compatible.

SM: There is one gap I see in making Jonathan the operational guru and Ed the marketing mind – who runs the software side? The game is changing. The convergence device game is a software game today. And Palm has so far failed to produce decent software. EB: Basically, this transaction gives Palm the opportunity for a turnaround and enables a very visible industry star, namely Jonathan, to recruit world-class talent to place in various key slots, including the software slot.

We've talked about the software role at a board level as well, and as Jonathan moves into his new role, one of the first things he'll do is create a core team of breakthrough innovators who have a track record of working together on the software side and the hardware side.

It will be a steroid injection of innovation. And innovation with an eye towards making money, which is what Fred Anderson will help appraise.

It feels like a good match. And it was one of the few options available that received full board support. I realize that for companies in this situation, where the founder is still on the board, it's a very hard decision to face. The choices are to potentially sell the company, or sell a good portion of the company, or entrust the company to a new chairman who has never worked for the company before. We had to create sufficient comfort around that, and we crossed that point in the spring timeframe this year.

SM: How long do you think it will take to execute? EB: I would say that it's going to take a full year before you start to visibly see the signs of a turnaround. It will take a product cycle, but the good thing about this industry is that the product cycle is very quick. I would say that before the end of 2008, Palm should give tangible signs that it has a strong innovation program and at the same time is able to deliver revenues and earnings.

SM: What is Elevation's investment thesis regarding positioning? Is it still a prosumer play? EB: The Elevation thesis is pretty simple. It basically says the smartphone market is at its very infancy, and the arrival of the iPhone is expanding the opportunity, making it more real to

more people. It is very clear that it's going to be a huge market, and we'll see an acceleration from feature phones to smartphones.

There are a whole bunch of stars aligning that suggest an acceleration of the market, and not just on the device side, but Web 2.0 is also a reality in terms of applications and available services. The transition to 3G is on the way, and we have Wi-Fi networks popping up everywhere. WiMax is no longer a distant dream. It's being rolled out by Sprint and Nextel, as well as Clear Channel. They're all beginning to create WiMax networks, and of course that's an emerging market as well. We're going to see high bandwidth for devices and a breakthrough market momentum.

We're also seeing a breakthrough in our ability to manage multiple radios. The world will now have a multi-radio environment – a 3G radio, a GPS radio, a Bluetooth radio, and a WiMax radio all on a single device or a small number of devices, where the signal processing is done in a multi-radio world so you can manage interference risks and such.

It's all good for the market opportunity available to Palm. It's a huge market, and it's not just products, but products and services and the software that unites them. That's the game plan, and I think it's pretty exciting for the company.

SM: This has been a very interesting discussion. Anything else you would like to add before we conclude? EB: On a personal level, things have worked out pretty well in the sense that I believe in 10-year cycles – at least for me.

I think you can get excited about a business concept for 10 years. Beyond that, particularly in a fast-moving field, it's hard to sustain a psychological excitement because you want to move on to new things. It's also important for other people to come in with new energy and perspective.

I've managed to do this, not by design, but because things worked out well throughout my life. The time I spent in various companies was ideal. I'm glad, for example, to have served exactly 10 years as 3Com's CEO because, frankly, I don't think it would have been interesting much longer. I'm glad I was the Palm chairman for 10 years. And right now, I'm having a blast working with young companies as a combination of angel investor, VC, coach, and teacher. I think I'll do this for a full 10 years and then hopefully move to something else.

SM: Thanks, Eric. It's been fun tapping into your broad business experience and thoughtful analysis.

[Note: 3Com managed to do a very nice turnaround between 2007 and 2009 and is in the process of being acquired by HP in 2010. This will dramatically change the dynamics of the networking business and challenge Cisco's hegemony. Palm launched new products, Pre and Pixi, between 2009 and 2010, and Jon Rubinstein became CEO. In April 2010, Palm was also acquired by HP.]

Paul Cook

I recently had the great honor to sit down with the legendary Paul Cook and hear the story of how he built Raychem from scratch.

Today, Silicon Valley has embarked on yet another evolution, committing huge chunks of capital on a genre of technology companies and entrepreneurs that have come to be known as cleantech. Years ago Raychem built an industrial powerhouse based on similarly innovative technology. With this backdrop, let us travel down memory lane with Paul Cook, the co-founder and CEO of Raychem, as he tells us a few things about how to build an innovation-driven material science company.

SM: Yours is a long story, Paul – where should we begin? PC: How about 1957? Actually, a few months prior.

Late in 1956, I rented a building in Redwood City, bought some used office furniture, and arranged to acquire the world's first commercial electron beam generator from the General Electric Company. I moved in on New Year's Day 1957. I hired a handful of people – Jim Meikle joined as a co-founder in February, and Dick Muchmore as the other co-founder in March.

The idea behind the company was to use high-energy ionizing radiation to cross-link polymers, imparting the capability to withstand high temperatures better. I had done research at the Stanford Research Institute, sponsored by the Atomic Energy Commission, and learned that commercial products made by exposure to radiation might well be feasible. It was my hope that the new GE unit would enable a safe and economical process for irradiating many products. The first product we attempted to develop was a specially compounded electrical insulation, extruded on copper conductors and exposed to electron radiation.

We received financial backing from Ed Heller, a well-known Atherton financier who'd supported startups before. Ed was a key predecessor of the venture capital world in Silicon Valley.

The prototype was delivered in March. We delivered samples of the wire products to prospective customers in May, received our first orders in June, and started shipping product in July. August was a profitable month. Bob Halperin and Bill Fritz joined the company on September 1.

SM: Yes, I know Bob well. PC: Our first crisis occurred in September, when the tube of our GE electron beam generator burned out. Halperin got the job of locating a new tube fast so our manufacturing could continue. But the new tube didn't work, nor the one after that, nor the one after that. Over the next three months, we couldn't manufacture anything – our customers became very anxious. We had to lay off about a third of our people and reduce all salaries and wages, all while trying to assure our customers everything would be all right.

It was the day before Christmas when we finally received a satisfactory tube from GE. We got running quickly, worked through Christmas and New Year's, and supplied our customers at just about the time their patience was running out. But they stayed with us. And all the employees who survived this crisis and stayed with the company received shares of stock in the company.

It was the start of a remarkable company. We developed five products in our first year, three of which became successful. We grew at a rate of 25% per year for 20 years – mostly from

products we invented ourselves based upon our pioneering technology.

In 1999, Raychem was sold to Tyco for $3 billion, on annual sales of $1.8 billion. All from that very humble beginning.

SM: If it's possible to break it down, what was the guiding philosophy behind the Raychem story? PC: The main principles I believe in, in terms of succeeding in business, are as follows: First, pick a technology niche that you can lead in, that others haven't done before, and that you can master. Then develop products based on that technology to enable high prices relative to cost, yielding a good gross profit. This will allow you to continue to spend on additional product development as well as investing in sales and marketing necessary for new innovations.

SM: In the Valley I see a lot of technologists who cannot think through the application. They come up with solutions and then go looking for the problems. PC:

You have to have a market pull. There has to be a market out there that wants your product.

When I started Raychem and we went into radiation chemistry, I selected as our first products wire and cable for aircrafts. By reducing the weight of wire it would reduce the weight of the airplane, which was worth something like $1,000 per pound saved for each airplane. If we could cut the weight of a cable by 3 pounds per 1,000 feet, and there were 50,000 feet in an airplane, that's a 150-pound savings, and that's worth $150,000 per plane. That's a huge amount of money. That meant the price we could charge for the product was high because it was so valuable to them.

SM: Can you walk me through the process behind the thinking? Was it the problem regarding the weight of the wire that came first, or did you have a technical solution to begin with? PC: You have to know the market, and I knew the market. I knew that if we could make a lightweight wire that was inexpensive, it would be worth a very large amount of money.

A technology push, if you don't have an existing market, does not work.

In addition, you have to know enough to know the value of the product you're trying to develop. If you're developing a low-margin product, you can't spend a lot of money developing the product. If you develop a product that has a very valuable market, then you can spend a lot of money developing it.

The first year at Raychem we developed five products. Three of them became successful, and two didn't because we couldn't make them. If we had solved the problem of the remaining two, they would have been successful as well, so it was a technical failure. The market is still there, but we moved on.

SM: When you look around today, here in the Valley, are you involved in any of these cleantech companies? PC: I have some friends who are involved, and it's interesting. I love and follow carefully the development of clean energy – or cleaning up dirty energy, which is perhaps going to be even more important. I think it's going to be easier and cheaper to clean up fossil

fuels and sequester carbon dioxide than to develop new renewable energy sources over the short term. I also believe that nuclear energy is going to be necessary as an economical source of energy as well. France has been such a leader in this field. I think 90% of their electricity comes from nuclear energy.

SM: MIT is putting a lot of effort into energy. PC: I had a breakfast meeting with the president of MIT, Susan Hockfeld, a few months ago, and it's amazing to learn that the entire institute – every department – has a major thrust in solving the energy problem. I'm delighted to see that. The problems are technical, but there are going to be many political problems to face as well.

SM: The question I want to get back to is that you said renewable sources, such as wind and solar, are higher-priced solutions, but they seem to be matching the model you are suggesting of this high gross margin, higher-priced product. PC: As long as the government subsidizes them, which is what they're doing, it will be. And I think the government should do that – it's important to the country. But in terms of impact, it will be a drop in the bucket, supplying only a few percent of our energy needs.

SM: So for a startup, the cleaning up of dirty energy is a more viable problem to solve for the next 50 years. If you were running a company that was going to go after that market, what process would you follow? PC: First, you have to figure out what you can do that nobody else can. You have to find what you're a pioneer of. The next thing you have to do is get strong patent coverage. The particular product or service you provide, based on your proprietary technology, has to have a handsome price-to-cost relationship – 2:1. Then you can afford to develop the product – if you have a projection of what it's going to cost to develop the product. As an executive, I usually take that and multiply by two or three because I know it's going to take longer and cost more than even the most conservative projections.

SM: Both the cost and time projections get expanded – double or triple the original estimate? PC: Exactly. If it's still promising, you can start.

SM: How do you manage the research and development process? PC: What I like to do is not very popular today. I like to have a central research organization that knows the whole field of technology in which you're working. They penetrate the key technical issues that you need to understand for development of future products.

In my case it was radiation chemistry, and we had to penetrate it on an almost academic basis. We understood exactly what happened when high-energy electrons hit a polymer, and we learned how we could change the effect. We knew how to develop an irradiated polymer that does things you want it to do.

That knowledge, developed by the central research organization, can then be used by the divisions concerned with developing products the customers want. The development process is done by an industrial division working on a particular market. For example, at Raychem we did it for the telecom market, the energy market, and the aerospace market. They're all separate divisions; they all had different sales and marketing people whose job it was not only to sell to the customer, but to know what the customer's problem was.

An example of this is the first product we made: an electronic hook-up wire that was much

lighter than the existing electronic hook-up wire. Because of the decreased weight, we could charge twice what the competitor charged. Instead of having a 30% margin, we had a 60% margin. That's the role of the various divisions; they take a technology that is available from the research areas and make it available as a product, or a series of products, that the customer needs and can afford to pay for. The market division is really commissioned to go out and solve the problem for the customer. It has to be something the customer wants badly and therefore will pay highly for.

SM: The core research remains within the central development team? PC: The basic technology is being developed by a research group that's trying to solve problems for the divisions. The divisions in turn focus on solving the customer's problem. The sales problem is typical sales, except you have to learn what the customer's problems are and know more about them than the customer does.

SM: What is the ideal profile of someone whom you put in charge of the R&D organization? PC: The leader of the central organization should be an outstanding scientist who is also very savvy about the marketplace. They cannot be a scientist whose sole concern is the science. They must be someone deeply aware of the marketplace.

SM: Is that a profile you found easily? PC: It's very difficult to find. I found one, Vince Lanza, and he was killed in a tragic commercial airplane crash. That set the company back a huge amount because he was so good. Unfortunately, our chief scientist, the director of research, was also on the same plane. We lost both our chief technical officer and director of research at the same time, and they were both very dear friends.

SM: After that incident, did you find someone else? PC: I never found anyone of that caliber again. Never.

SM: In terms of the divisions – whom do you put in charge there? PC: There you look for someone who is totally market oriented with a strong technical background. We hired many, many people who had bachelor's degrees in some technology, then a business degree. We hired more Harvard Business School graduates per capita than any other company in the Bay Area – probably the entire United States. Harvard and Stanford were the two most highly represented business schools at Raychem. Those people were market oriented, sales oriented, and business oriented, which was a combination we used to head up divisions. They were there to run a business.

SM: We talked about the organization, pricing strategy, and how to scope out the technology and market. Anything else? PC:

Beyond hiring outstanding people, which is absolutely key, you must train them.

I believe in an extensive training program, teaching the new recruits knowledge of the technology, the products, and the markets. We put them through a several-week training program and then held a final exam in my office, with about a dozen of the trainees. We actually flunked a few people. Not a lot, because we were so careful in whom we hired, but a

few flunked. Hiring the best people and keeping them is important. You have to offer proper stock option plans and salary to attract the best people.

So you must have technology, market, people, and you must be devoted to the customer.

> ***It's not just a question of selling the product. You have to teach them how it works; you have to be there all the time; you have to flatter them; and you have to know more about their business than they do.***

It's old-fashioned selling along with great knowledge of the products and the business.

SM: When you look at a customer's problem and begin developing solutions, you are essentially selling concepts. You don't always have the product ready yet. PC: That is very correct; we often sold concepts.

SM: Especially with industrial markets, those companies are not early adopters at all. PC: Our manufacturing managers used to tell us we would sell a product before they knew how to make it. However, they always figured out how to make it.

SM: How do you handle customer interaction in that scenario? PC: You have to get the customer to love you. They have to believe in you, they have to trust you, and in return you have to have the highest ethics.

SM: Before Raychem became Raychem, in those first five products you tried to bring to market, what did you do to win customer trust? PC: Let me give you some examples. We would go and learn about the needs of Hughes Aircraft, a big electronics supplier to the aircraft industry. We would learn about a problem we thought we could solve, and then we'd come back and have a meeting with our top executives to decide what it was we thought we could do. From there, we'd return with a printed proposal of how we would solve their problem. Then we would provide samples, visit them weekly, get to know everyone in the company important to buying decisions, and show them the significant advantages of our product.

SM: It was relationship selling as much as anything else? PC: Absolutely, but with a strong emphasis on technology – our strength.

SM: You mentioned ethics – what role does that play? PC: I want to emphasize the role of ethics because it is so important. The company has to have the highest ethical standards. Everybody has to believe in the fact that the company is honest and ethical – it's the cornerstone of the confidence the customer has in the products. And customers have to have confidence in the products, the people they deal with, and the company. At Raychem, when we employed 50 people, we sold a whole wiring product line to Lockheed for their entire missile and satellite program. It was amazing. We were picked because we were lighter in weight, which on a satellite is more important than even on an airplane. But the key point is that they had to have confidence that our small company would be stable, financially strong, ethical, and competent as a manufacturer.

SM: Do you wish Raychem was around as an independent company today? PC: Yes, yes

I do. But I made the decision to retire at 66 because I believe the CEO has to be young and vigorous. When I retired, I decided the best thing would be to get away from the company and let the younger people run with it. I even resigned and retired as the chairman; I was not on the board when the company was sold to Tyco Electronics.

SM: I wonder if you had the trunk of a $3.5 billion company today with the sales channel and the innovation culture, and if you pointed that engine at the big problems of our times – energy, water – couldn't it be so much more powerful? This company does not belong inside of Tyco. PC: No comments on that.

SM: I understand. PC: I believe that mastering a technology, finding a market need, and developing solutions for that need can solve many of the world's clean energy needs. Certainly our best people are now addressing those needs with conviction, intensity, and intelligence. I think we'll begin to see results quickly.

SM: Thank you, Paul. This has been an absolute honor.

Innovators in Academia

Universities Need to Play Bigger Roles

In an ideal world, a capitalist framework would deliver all the economic progress essential to an evolving civilization. Unfortunately, we don't live in an ideal world. And innovation, which stands at the very core of capitalism as we know it – private, free market, borderless, and without government intervention – has become hazardously stagnant.

The Internet, one of the greatest innovations of the twentieth century, rose out of the US government's Defense Advanced Research Projects Agency (DARPA) and MIT's Lincoln Lab, way back in the 1960s. A time when ovens rather than microwaves baked potpies and telephones rang on and on in empty houses, for not only was the cell phone 35 years away, but the answering machine was still 20 years off.

Without DARPA and MIT's absolute commitment to the project, the 30-year research and development period that brought the Internet to commercial maturity would have been unsustainable. A pipe dream. For such a gestation period is simply not viable without government funding, and such innovation is impossible without the incubating ecosystem of universities and research labs.

Does that mean capitalism is not key to innovation? Absolutely not. Once innovation is ready to be brought to market, it is best for academia and government to hand it over to the market.

It is an intricate dance, this tango between industry and academia – with the government DJing in the background. Few have learned to dance it well. MIT, Stanford, Berkeley, and Carnegie Mellon headline an elite list of institutions that consistently bring university-led innovation to market. Examples abound from those schools: Google from Stanford; Cadence from Berkeley; Akamai from MIT.

My former adviser at MIT, Professor Anant Agarwal, one of the pioneers of multi-core processor technology, has more recently spun his third company, Tilera, out of MIT. Tilera is based on research that I myself was part of almost 15 years ago, though multi-core computing only started gaining traction in the last five years. The R&D was done on DARPA funding, though VCs now fund the commercialization efforts.

Having experienced firsthand the tremendous benefits of the innovation infrastructures at US universities – something no other country in the world has so far been able to develop to this level – I have come to several conclusions. First, the US still can, and needs to, lead the innovation charge. Second, within the US, the technology transfer from university to industry via entrepreneurship needs to become much more widespread, spanning not just the elite schools but infiltrating the entire US higher education system. Third, the US needs to teach the rest of the world how to develop a strong innovation infrastructure that will lead to the commercialization, entrepreneurship, industry creation, and job creation essential to a thriving economy.

Recently, I was pleasantly surprised to speak with an entrepreneur who comes not out of MIT or Stanford, but from the University of Toledo, Ohio. Chinese entrepreneur Xunming Deng has been building his thin-film solar cell venture, Xunlight, with close to $20 million in research grants and $40 million in venture capital. Before joining the university, Deng worked at a photovoltaic production company, Energy Conversion Devices. Deftly combining his knowledge of production-line technologies and inefficiencies, and armed with a real talent for raising R&D grant money, Deng is tackling areas of innovation that require both large capital and long gestation periods. And by the looks of it, he is succeeding. Deng's dream: create 5,000 new green

jobs in Ohio.

Indeed, we need to educate thousands of other academics – scientists, technologists, and innovators – in this art of entrepreneurship. In the US today, the Kauffman Foundation estimates that only a dozen successful university entrepreneurship centers are up and running. The Deshpande Center at MIT, the Stanford Technology Ventures Program, and the Center for Technology and Entrepreneurship at Berkeley are among the most notable – and all of them are found within engineering schools, not business schools. This tells me that every engineering school must embed an entrepreneurship program within its fold to simultaneously train technologists in both science and the business of innovation. Research projects should be chosen on the basis of their market potential to solve real-world problems, instead of technology being built as solutions looking for problems.

In India, although the Indian Institute of Technology campuses have each begun their own incubators, the level of R&D is still quite basic. The key issue there is that the IITs are undergraduate teaching schools, while MIT, Stanford, and Berkeley have prestigious graduate programs focused on true research. So for India, one of the immediate next steps would be to develop an extensive, government- and corporate-funded R&D infrastructure. One where the innovators of tomorrow, be it in cleantech or software or some yet unnamed endeavor, can hatch plans for the 2020s and 2030s.

The world that emerges from the ashes of the 2008 financial crisis needs to elevate such innovation to a central priority. It is crucial for both today and tomorrow.

Tom Leighton, Akamai

Tom Leighton, co-founder of Akamai, is the company's chief scientist and a member of its board of directors. Akamai Technologies is the leading content delivery network (CDN) provider, which, among other things, allows content providers to accelerate the delivery of Internet content and applications.

SM: Tom, I would like to start the conversation with your background. TL: I grew up in Arlington, Virginia. I attended public schools there and then went to college at Princeton. I came to MIT for my PhD and postdoc, and then I stayed on as a professor of mathematics.

SM: Take us back to the beginnings of Akamai. What was going on in the industry, and what was going on in your research group? TL: I was running the algorithms group at MIT back in 1995, and Tim Berners-Lee was running the Web consortium. Tim was interested in issues with the Internet and the Web, and he foresaw there'd be problems with congestion – hot spots, flash crowds – and that the centralized model of distributing content would face challenges. He was right. There were considerable challenges, and it was simply not going to scale. He presented an ideal problem for my group to work on.

We started researching in 1995, and in 1996 Danny Lewin came to our graduate school and became my advisee. We worked on developing algorithms and programs for distributing content on large-scale networks, doing that efficiently. In 1997, we entered the MIT $50K Competition – a student-run business competition at MIT. Through the course of that year, we were exposed to businesses, potential customers, content providers, and VCs – people who were interested in backing companies with good technology. We never thought about creating a company; to us this was purely an academic effort.

[Daniel Lewin became the co-founder and original CTO of Akamai. He was on one of the American Airlines flights that crashed into the World Trade Center on September 11, 2001. He was 31.]

SM: Even though you had entered the $50K Competition and started talking to potential customers, Akamai was not yet a company? TL: We really had no desire to make a company out of our research. We were all academics, and we liked writing papers, proving theorems, and giving talks. We were not businessmen in any sense of the word. In fact, at the end of the $50K, we were approached by people interested in funding a company, but we decided not to incorporate at the time.

We had written papers and written algorithms, but we hadn't written a lot of code yet. There is a major difference between proving a theorem and actually coding systems that really work. So over the course of the summer, we worked on the business plan some, changing the model to what it is today. We wrote a lot of code and convinced ourselves it could really work. It could be a successful company and be profitable, and we were convinced this was the most effective way for the technology to get out there and make a difference. At the end of the summer of 1998, we incorporated, left MIT, and sought funding.

SM: Tom, two questions come to mind. First, who would you describe as the "we" at the time? And second, what was the business model you developed? TL: We got a lot of good advice from Battery Ventures. Todd Dagres was very helpful, and he became our lead VC. The old business plan was to sell caching technologies to ISPs. But by talking to the ISPs, we quickly discovered they had bigger fires burning. They were going broke and couldn't afford to pay. Then we started speaking with large Web sites – CNN, Disney, Yahoo! – and discovered they were very concerned about scalability and performance quality. They had a financial incentive to make their sites scalable, and they would pay us for solutions. So we changed our business model accordingly.

SM: What was the architecture you used to launch Akamai? TL: It was an object delivery technology. In essence, you could take the objects in a page that are static and cacheable and cache those and deliver them locally. The underlying principle regarding the architecture of the network is the same today as it was then. We want our servers in every city where the end users are. So the end users interact with an Akamai server a couple miles away instead of going through Internet peering points or long distances, as that is how you make the service really fast and scalable.

That business model is still unique in the industry today. We're in 900 ISPs, and we'd like to double that number. I'm not talking about peering either; we're physically in those ISPs. If you're peering to get to the end users, you're on the wrong side of the equation. You want to be where the end users are; you don't want to go through congestion points to get there.

That architecture is where we started way back in 1995, and it's still unique today. To make it work in practice, we had to develop a lot of technology. We did a bunch of that at MIT, and a lot after we left MIT, in order to make distributed computing on that scale possible. Back then nobody thought it was possible. It was an ivory tower kind of concept. Today it's widely accepted. We have servers in 1,600 locations, in 750 cities, and over 900 different networks.

SM: Let me ask you a couple detailed questions on that framework. You have servers inside of various ISPs, and the intelligence in that server is your technology – that is how you route traffic? TL: At a very high level that's correct. There's a lot of detail and things we do that go into making that happen. But at a very high level, we're not an ISP, so we don't route traffic in the traditional sense. How we move packets from one server to another, how we direct end users to get to a machine that is very close to them, how we handle load balancing and fail over, and what functionality we get into servers near end users – these are the key problems we solve. Originally it was static content, but now full applications can run there. That's what makes us unique.

SM: You have been in business nearly 12 years now, and of course the volume of traffic and the level of richness in the Web has expanded significantly. So has the level of technological understanding and capacity inside these ISPs and telecom operators. How do they view you today? TL: The telecom operators and ISPs view us as a very valued partner. We save them money, and we improve their performance to their end users. When our servers come in, they arrive with the 20,000 most popular domains preloaded. We give their users a faster experience.

We also help them with Internet events. If there are attacks or large media events, such as a big software download or a big virus patch, ISPs love having Akamai servers. It's a very

symbiotic relationship, beneficial to both parties.

To understand the how of this you have to look at how the Internet has scaled. The Internet has grown in capacity, but in disproportionate ways. In the last mile you find the edge ISPs, which is where we have the majority of our deployment. The content delivery capacity has gone up by a factor of 50 to end users. I had a 256K modem; I now have a 15 meg service, and my father has a 40 meg service. You have a big pipe going into his home. On average, over the last five years, you've had a factor of 50 increase in the last mile of bandwidth, while the first mile, where the data centers are located at the core of the Internet, has grown by a factor of 20.

The big problem with the Internet has been the middle mile – the peering points between the big networks and the smaller local networks, the big hauls. That area has, more or less, grown by a factor of only six.

There you have the little ISPs paying big ISPs for transit. But the big ISPs get into fights over whether or not they should be paying each other. You see the incidents where level 3 ISPs will fight over deep peering – they're arguing over who should pay whom, and what should be paid. They're all under financial pressure, and the result is that those connections are not upgraded as fast.

A little ISP, in order to save money, is willing to be congested for an hour a day during peak traffic. So you have this bottleneck, which is sort of the big middle mile, the long haul, going from network to network and through congested peering points, and the Internet routing protocols ignore congestion. There isn't any ability to route around congestion areas using normal protocols.

That's why Akamai places its servers in the last mile. That gets us beyond the bottleneck. All our competitors place their servers in a few core data centers. It's a lot easier to think of managing 20 locations, but it doesn't work nearly as well, and it inherently limits scalability and performance. That's why Akamai is so much faster and has so much higher quality in the delivery of content like video.

SM: That's a good transition into the question about what the impact of video is on the Internet. Video is a different type of traffic, and it has really ballooned in the last few years. What does that do to Akamai, what does it do to the Internet, and what are we going to see?
TL: Video increases our traffic, which is good for our business. But it increases the burden on the Internet, which is bad for the Internet.

The good news and the bad news is that we're just at the tip of the iceberg on video.

Downloading a video is about 1,000 times the traffic of an iTunes song. If we really get TV- or DVD- or HD-quality video into the home, that's going to explode the traffic on the Internet. We haven't even seen the beginning of the impact on the Internet yet.

We're supporting HD video with our product, but it's relatively small scale. The content delivery network and services, which are organized at the core and the data centers, are going to hit a wall. They'll buy bigger and bigger pipes at the data centers, but the peering points will remain congested.

Akamai is in a great position there. As we think about growing our capacity over the next few years, we're thinking to the order of a couple hundred terabytes per second to support a large audience for TV and video. The only way you can do that is by serving that content locally. You're never going to get that capacity out of data centers.

I think there have always been companies doing the core data center approach. It's easy to do. You buy servers, stick them in a data center, and give it transit. You can start a company very easily with that model. There are probably two dozen companies, a dozen of which started in the last year, doing just that. It's quick, dirty, and cheap.

But you then find out your quality is not good. And of course, you get the argument that quality doesn't matter for video, so who cares if the latency is large? In fact, it does matter. Latency drives the throughput. If you're trying to deliver video from the data centers, say 20 data centers around the world, for a lot of end users, you won't even be able to deliver TV quality, let alone DVD or HD.

SM: So you are saying that centralized data centers have higher latency, and thus lower throughput, and that prevents TV-quality video or higher, making the video-on-demand experience unsatisfactory. Is there an example of this you could give? TL: We have a great case study we did in Japan with what is probably the world's largest media company. They were comparing us to our largest competitor for video delivery. In this case, our competitor was charging a lower price, and this company wanted to know why they should pay more for our solution.

Their thinking was that it doesn't matter where in the world the video comes from as long as they can deliver it. We suggested they do a trial so they could see how long it takes Akamai to deliver a two-hour DVD versus how long it takes the competitor. During the trial it took Akamai well under an hour, and it took the competitor eight hours.

When it takes eight hours to deliver a two-hour DVD, you're not on-demand – you're waiting overnight for your video. Anyway, they're now an Akamai customer.

SM: I was talking to one of your customers, Nick Rockwell over at MTV, and I asked him about what open problems this massive scaling of video has caused them. One of the points Nick raised was the whole issue of variable bit rates, especially in the last mile. If I am downloading a video, and then someone next door starts downloading a big video, I lose bandwidth. They don't have a good idea how to handle things like that yet. TL: That's precisely my point about congestion in the middle mile. As you move farther away from the last mile, you get aggregated. Everybody tries to watch their movie, and you're not sharing it near the last mile – you're going to swamp out the connection in the middle mile. That's the problem. That's why Akamai is placing its servers so close to end users. If you have the server in the last mile network, you and your neighbor can watch the movie at the same time.

SM: How close to the last mile can you get? You are going to need millions of servers to cover the world. TL: I don't think so. The way we think, a server can serve a gigabit a second. It's pretty economical. If you look at TV quality, you can support 500 viewers off a gigabit a second. If you have a TV audience of 50 million, that's 100,000 servers. That's where you'll probably see us, in that ballpark.

SM: Your CAPEX and OPEX for expansion are in these servers, not in acquiring bandwidth. TL: CAPEX would be the cost of the servers, yes. With bandwidth, sometimes we pay for transit. But often we don't because we're providing such a benefit for the ISPs by optimizing their traffic. So that wouldn't be a big expense. Our goal is to make the cost so low that we can pass on the low cost to our customers. We have a very good track record of

decreasing costs to our customers over time.

SM: Akamai has the media place really nicely locked up. Anybody doing consumer-facing media needs to use your service in some form or another. Where are you expanding beyond this content delivery service? TL: First, for many years now we have moved beyond just delivering content, towards accelerating applications. Say you're running search on a site, you're buying something, you're handling customers, or you have a corridor of some kind. These are applications that are personalized, dynamic, and non-cacheable – quite possibly secure over SSL. We built services that make those run a lot faster and more reliably, especially on a global scale.

SM: How do you provide fast, reliable service globally? What is the secret there? TL: There are a bunch of things we do for that. In the old adage, having our servers near the end users rewards them. We sit on top of, and find better routes on, the Internet. We don't change the protocol, but we tunnel traffic through other Akamai servers that would not otherwise be on the path. This gives us the ability to find good routes on the Internet when a given route has congestion.

A great example is when the Taiwan earthquake hit. A lot of folks not using our services were disconnected from key parts of Asia for extended periods, while Akamai customers did great. They didn't even realize there was an earthquake.

For dynamic content, we do intelligent pre-fetching. Say we're delivering the HTML to a client from a local Akamai server; as we're delivering the HTML or the JavaScript, we'll be parsing it. We'll see what other links are there, and we'll go and fetch those other links within the HTML ahead of time, and when the user comes back, instead of going across the world to get it, it's already right there. It's like a static cache, even though it's a rich, dynamic environment. The end results are that we can make the application, from end to end, run a lot faster. We're not as well known in this area of business – we're known for big media – but really the fastest area of growth for us is application acceleration.

SM: What kinds of customers are the early adopters of application acceleration? TL: We don't have only early adopters anymore. We have over 200 brand name customers. Phillips Medical, Caterpillar, and Audi are a few I can mention.

SM: Is there an application pattern with them? Are these e-commerce applications, business applications? TL: Everything. B2B commerce, CRM, global portals. If you have a business application and you're dealing with remote offices and clients or remote business partners, we'll make it profitable.

SM: You are able to expand your total available market massively with the application acceleration offering. TL: It's not really CDN anymore. Other companies that do CDN most certainly do not do this.

SM: One of the concerns you must be facing now is how big can the CDN business be, and how fast can it grow? I'm sure your investors like the diversification as it is both risk and business diversification. TL: We consider it to be a really critical part of our future. I should also mention that in the media area, we've also done a lot of work, partly through acquisition and partly

through internal development around content management for media assets, link syndication, things to make it a whole lot easier for our customers to manage their content, in addition to just delivering it.

SM: Manage their content in what sense? TL: Imagine someone like the NBA – they have all sorts of film clips coming in from all types of sources. By halftime, they would like to have the clips up from the first quarter, from all of their assets. Link syndication means they would like their preferred partners, whom they're getting the most revenue from, to get access to the best-quality video. Maybe there's a partner who is not a preferred partner, so for that link they'll de-prioritize and offer a lower quality version of the video. Maybe there are other sites with which they don't have any business relationship. Those sites will get blocked. It's all the same link, but depending on the business rules for who is asking, you'll get something different. Managing that whole thing, making the metadata tags around the videos, there's a lot of work that goes into the whole operation. Our Stream OS does that, in part due to the Nine Systems acquisition.

SM: What are some of the new areas you are expanding services into? TL: One place we have services now is with user-generated content. In the old days, it was all from the content provider to the user. Today it's amazing how many sites have user-created content to bolster a user-generated community. We all know about MySpace and YouTube, but there are a lot of others as well. You have millions of users all wanting to upload different files at the same time. So we've put a lot of resources into building the infrastructure that allows them to quickly get the upload, store it, and provide access to it using the content delivery channel. We've invested a great deal over the last couple of years to do that. And today, the majority of the social networking sites interested in user-generated content can use Akamai to manage these operational challenges.

SM: What kinds of problems have you identified as big open problems you need to tackle in the labs? TL: We're always working on making the service faster, scalable, and more reliable. We have a team of folks looking for the 1 in 10,000 to the 1 in 100,000 "nasty thing" that prevents content from getting delivered on the Internet.

> ***We're constantly testing the sites we carry, and sure enough, with the Internet, something won't get delivered correctly. We're always investigating in order to make the service better and better and better.***

Today we have about a factor of 5–10 fewer errors than our competitors. We're always trying to make that margin bigger.

We're also trying to make the service faster, and that means more deployments at ISPs – better technology. For example, if you bought the Web application accelerator service from us a year ago, today you find it's even faster. You didn't have to do anything for that or pay us any more, that's just what we do.

SM: Are solutions to these problems in the domain of CAPEX/OPEX, or are they in the domain of mathematics, or both? TL: The solution is really in the domain of R&D. It's facilitated by CAPEX and greater deployment. But just spending more on CAPEX doesn't make you faster or more scalable. It's the R&D that enables that to happen.

There are people thinking about how to make us faster and how to make us more reliable. We

just received PCI compliance, and we're the only entity out there that has been certified for that. We carry a lot of SSL for credit card transactions. We're working on incorporating a client assist, a P2P assist, in a very controlled way for downloads where performance is not as critical, but the customer is looking for less cost for file downloads.

We're also working with the big application providers to ensure Akamai is very easy to embed in their applications. If you get SAP, it's almost trivial to have it become SAP accelerated through Akamai. Those are some of the things I can talk about. Otherwise, there are always some major things in R&D that cannot be discussed.

SM: Well, thank you for discussing what can be discussed. The market awaits your secrets.

Xunming Deng, Xunlight

Xunming Deng's story is a notable example of serious entrepreneurship born from a non-elite school: University of Toledo, Ohio. The vast majority of universities have had little success in creating strong technology transfer, innovation, and entrepreneurship programs. They lack both mentoring and investor networks, as well as access to customers and deep knowledge of the mechanics of business.

Xunming's case is an exception. He has not only been able to access serious government and venture funding, but he is steadily progressing into the commercial domain, accessing customers.

SM: Tell me where your journey begins. Where are you from, and how did you end up at the University of Toledo? XD: I was born in Nanchang, China, in 1963. I grew up there and went to college at the University of Science and Technology of China. In China we have a nationwide college entrance exam that you must take in order to attend university. I happened to be lucky enough to be ranked first out of 100,000 students in my province, which allowed me to get into a prestigious college.

I studied physics there and then came to the United States and enrolled at the University of Chicago in their physics program. That was 1985. I pursued a PhD in amorphous silicon and photovoltaics. I've been working in photovoltaic sciences for 23 years.

Upon graduation from the University of Chicago in 1990, most of my classmates went on to do postdocs. I went to a small technology company to build photovoltaic production lines.

SM: Which company did you do that for? XD: Energy Convergent Devices, which when I joined was in Troy, Michigan. I joined the company in 1990 to help with their amorphous silicon production lines. Soon I was in charge of the technical team, working to optimize all of the advanced production lines. That was a lot of fun.

In 1996 I moved to the University of Toledo to become an assistant professor. Many of my colleagues thought I was nuts – I gave up a senior career at the company to become a junior professor. A few years later, I went through the ranks to become a full professor. Then in 2002 my wife and I started Xunlight.

SM: What was the genesis of the company? Was it based on research you were doing in your lab at Toledo? XD: Yes. When I went to the university, we developed a set of technologies, such as how to build efficient solar cells, how to increase the production rate, and how to reduce the cost of equipment. Having been involved with production lines before, I had a good understanding as to what was needed in the industry to be more cost-effective. That's a perspective many professors don't have.

SM: You were more familiar with the commercialization of technology because of your industry background. XD: Exactly. In the university environment, there are very few professors with such experience. Those who do have experience are from Bell Labs or other large corporate research institutions. There were very few who had startup or small technology company

experience.

The difference is that those who've worked at a small technology company have learned how to survive.

SM: That is certainly a different field of experience. XD: Very different. Everything is based on small, limited budgets, yet you have to build a great team and the best products on the market.

SM: When you went to the university, you essentially went to carry on the type of work you had been doing at ECD? XD: As soon as I arrived at the university, I quickly built my team and developed high-efficiency solar cells. We then pursued government grants from National Renewable Energy Labs, the Department of Energy – all kinds of sources.

SM: How easy was it to get grant funding for solar energy during that time? XD: This was in 1996, so the timing was good. When I was at ECD, I was the principal investigator for its research programs for National Renewable Energy Labs. When I joined the university, the labs were already familiar with my credentials. That put me in a good position to get my funding as a professor. I then applied for funding from the DOE and the National Science Foundation in partnerships with other professors. Even on the academic side, you must have money before you can build the team.

SM: Tell me a bit about what was going on in the photovoltaic market. What was the lay of the land, and what deficiencies had you noticed in your research that enabled you to earn grants? XD: While I was at ECD, we developed some innovative products and product lines, but the problem I always encountered was the high cost of the machinery required to produce them. I figured if I were able to cut the cost of the machines by a factor of two or three, then the price of the products would drop substantially and open up a whole new market area.

SM: Your thesis was that it would be very beneficial to innovate in manufacturing equipment? XD: Exactly. It seemed to me that the current equipment was way too expensive. Right now people are investing hundreds of millions of dollars into production equipment because there's a strong market for it. In the 1990s, that was not the case.

SM: What happened next? XD: When I arrived at the university, I realized that in order to cut the equipment cost by a factor of two or three, several things had to happen. But if we did focus on those things first, it would lead to new production processes and equipment. I considered that to be the best way to penetrate the amorphous silicon photovoltaic industry.

SM: You secured funding from the NSF and various other sources. How long did it take to build up enough technology to validate your thesis? XD: I did struggle some, balancing the typical theoretical research done at universities with the more applied, production-oriented research I wanted to do. But in the end it has all worked out: my students graduate with PhDs and actual skills that make them very easy to hire, and we have actual devices that the university can showcase versus only published papers.

In the end, having all the applied research with actual devices made us more competitive in the grants process. Other universities put up examples of published theory, while my team was putting up actual devices alongside published papers.

SM: Awareness of alternative and renewable energy before 2003 was much lower than it is today. It started picking up on a global scale in 2003–2004. Getting grants instead of venture funding seems like a good route to have gone in that particular timeframe. XD: It was good, but it was pretty tough to get those awards. We had to demonstrate continued, solid progress in the lab. I built a team based on my first grant from the National Renewable Energy Lab. Our team then demonstrated high-efficiency solar cells as well as our ability to make solar cells at a higher rate than existing processes. Those were very important things. So in 2002 my wife and I decided it was a good time to start the company.

SM: What is your wife's background? XD: My wife has a PhD in chemistry from the University of Chicago. We're both from the same city and both ranked number one in our college entrance exams for the province in different years. We went to the same college in China and the same graduate school in the US. It seems that the only difference between us is I studied physics and she studied chemistry.

She did a postdoc at the University of Michigan and later joined me at ECD, where she worked on nickel hydride batteries. After I moved to Toledo, she started teaching physics part-time at the University of Toledo as well. In 2002, when we started the company, she actually took the lead in submitting grant proposals.

SM: Did you have any initial funding in 2002? XD: We put in $10,000 ourselves. That allowed us to buy chairs, desks, and computers. We then started submitting proposals to the federal government under its Small Business Innovation Research (SBIR) program. At the end of 2002, we submitted one to the Department of Energy for $100,000, and we got the award.

SM: At that time were you still planning to build an equipment company? XD: The funding we received was through an SBIR, so we had little choice in the direction of our work. We set up a small research and development team to work on neutron detectors using amorphous silicon detectors. It was related to what I'd done in the past and with our hopes for the future, but it wasn't directly in line with our ultimate goals.

SM: What are amorphous silicon detectors? What was the application they were going to be used for? XD: The application was a detector to measure neutrons for medical applications. Oak Ridge National Labs would have been the customer.

SM: So you did some government contracting to build up the early stages of your company – how long did that last? XD: It was a nine-month project. However, at the same time in 2003, we were awarded a National Science Foundation project called the Partnership for Innovation. The award was to the University of Toledo, which supported us as a spin-off company with a $25,000 grant. That grant was to develop a new process for photovoltaic and hydrogen generation.

SM: In the grand scheme, $25,000 is not a lot of money. How did you manage to build a

process with such limited capital? XD: It served as bridge funding. It was enough to keep the company going until 2004, when we picked up three projects. The biggest one of those was a $2.9 million project from the DOE.

SM: A $2.9 million grant sounds like real money. What was the project? XD: It was to build a hydrogen generation system using solar. At that time fuel cells were very hot. Of course, a fuel cell needs fuel, which happens to be hydrogen. We found that the solar cell, based on amorphous silicon, was a perfect candidate to generate hydrogen using an electrolysis process. You have a solar cell that you immerse in water. Under sunlight the solar cell will generate a voltage, and that voltage will split water into hydrogen and oxygen. The hydrogen can then be collected and used to power cars.

SM: Very interesting. How far did that project get you? XD: That, along with a couple smaller $300,000 awards, got us through 2005. The $2.9 million grant was over a period of years, so we received funding incrementally. By the end of 2005, we had some internal resources that we used to design the production line. Then in 2006 I started going after venture capital based on that production line.

I went to Silicon Valley and presented our business plan at the CleanTech Venture Forum. I had never presented my work to the venture capital community before, so I wasn't experienced. I came in with a perceived background of being a university professor and scientist who'd been living off government grants. Everybody was speaking a whole new language that I didn't understand. But people did notice I had a lot of passion.

SM: And a lot of technical expertise. Not a lot of people have that specific type of expertise. XD: I did have the expertise, as well as an entire university lab behind it. I had 20 people in my lab and a lot of multimillion-dollar grants by then.

SM: It sounds as though you are a great grant writer. XD: There were grants, not only from the DOE, but also from the State of Ohio. They invested $2 million in my university lab. The university and our company had a license agreement. Everything we developed was owned by the university because I'm faculty there, but the university provided exclusive license to the company. The university would get a licensing fee, royalties, and a piece of the company. They were happy because of all the grants coming in. When you have a spin-off company, everyone wins.

SM: It is great for the university because it sends the signal to the government that it is an institution that can take technology into industry. XD: Exactly. The university used the $2 million grant from the State of Ohio to invest in the lab equipment, which supported the company. The situation worked out perfectly for the state because it invests in emerging technology and education at the same time.

SM: What happened when you came to Silicon Valley to raise money? XD: We were successful – we showed the venture capitalists that the company had built a production line for the university using only grant money.

In essence, we had already proven our ability to succeed, and I had the same team

ready to do it again.

SM: How much money were you able to raise, and from whom? XD: In 2006 we had a lot of offers. It was all very sudden for me. Our company was courted by angel investors, venture capitalists, banks – all sorts of groups. However, I never felt the terms offered were very good. We only took $500,000 from an angel because we already had a large number of grants. I figured if we kept working through the grants, we wouldn't have to dilute the company.

SM: You are absolutely correct. XD: Usually, at that stage if you take $10 million, then you've really diluted the company.

SM: If you had government grants, why did you pick this angel investor? Was it an opportunity to bring in expertise? XD: No, it was just money. I had a team of advisors who were already helping me, including our lawyers and people from the business department. At that time I just needed $500,000 to demonstrate a machine. A few months later, in early 2007, we built the machine and it worked. Then we suddenly had four investment term sheets, which were all very favorable terms to us and gave us a favorable valuation. Emerald Technology Ventures led a $7 million round.

SM: How did they find you? XD: In late 2006, I presented at three different venture forums. One was the CleanTech Venture Forum I mentioned earlier. I also presented at the Energy Venture Fair and the NREL Industry Growth Forum. Word got out about our company very quickly, just off those three forums.

I started getting a lot of phone calls and had a lot of inquiries from people who wanted to come and visit. Not a lot of people wanted to come to Toledo – it's a bit out of the way – however, people were taking two- to three-day trips out to see us. That's when we started to see a lot of term sheets coming in.

About the same time, we used the $500,000 from our angel investor to build a demo version of our machine and product. That changed everything. We had a machine, a product, and a team.

SM: Did you have customers? XD: We had a lot of customer interest, but we hadn't signed an agreement with anyone. We make flexible solar panels, so our market is very broad. ECD had been sold out of some of their lines for many years.

When we introduced our product, we presented at a trade show. From there our product was carried in several magazines covering the industry. Flexible solar panels made big news – it was a hot product that people wanted.

SM: What did you do with the $7 million you raised in 2007? XD: We built a two-megawatt pilot line, which is a roll-to-roll production line, to produce flexible and lightweight amorphous silicon PV modules. It was almost identical to the full-scale production line we designed for later build-out. We used the same prints for both.

SM: When did you actually start closing customers? XD: We haven't sold a product to customers yet. But we've signed letters of intent for about $800 million in product. We've introduced product into trade shows, and that has generated enormous interest. And we're getting ready to sign a product purchase agreement that's worth a few hundred million dollars.

SM: Let's talk more about the letter of intent process. XD: Most of our customers come to us because they've only been able to source their requirements from one company.

SM: Which is Uni-Solar. XD: Yes. Uni-Solar is currently the only company producing flexible solar roofing modules that are commercially available. We're going to be the second source. But our costs are potentially going to be much lower, and we have plans to expand our capacity much faster. That's why there's so much interest in our product.

In terms of taking our product to market, though, I want to take a conservative approach and make sure our product can survive all the torture in environmental testing. Our products must be really robust before we sell.

SM: Aside from Xunlight and Uni-Solar, there is nobody else that does production lines for photovoltaics? XD: Many people are trying to build large-scale roll-to-roll production lines to manufacture flexible solar modules, but we and Uni-Solar are the leading companies. We're the closest to bringing products to market.

SM: Where are your manufacturing lines going to be? XD: Our roll-to-roll production lines will be here in Toledo.

SM: I am assuming that you are doing your manufacturing in Toledo because of your ties with the university? XD: It's where our company has grown up. We've had the governor and lieutenant governor over at our facilities. We've also had our senators and congresswoman come visit. There's a lot of excitement over a home-grown technology company. It's a university spin-off success story.

SM: That is wonderful. Have you done your research on how to access some of the stimulus money President Obama is assigning to renewable energy projects? XD: Yes. We've applied for a loan guarantee program, which we would like to use to build more production lines. The first large-scale production line is almost done. It will then go through a three-month optimization process, after which we can produce product.

SM: You said you have $800 million in letters of intent. What do you think that will translate into over the next two to five years? XD: Basically, for every 100 megawatts we can create over 1,000 jobs. We would like to grow to around 500 megawatts. That would allow us to create some 5,000 jobs. Direct jobs in our plant may be fewer in number, but there will be a lot of new jobs with vendors. We also plan to hire a lot of contractors to help build the line because there are certain jobs that only need to be done once. My estimate of 5,000 jobs includes the entire supply chain.

Ohio is a state that's really looking for good news stories right now, and I think we have the ability to become one of those. It certainly has been a good environment for us to get our start, and it's a good example of how the University of Toledo can help get highly innovative technologies transferred to the commercial world.

SM: It is very refreshing to hear a story of innovation out of Ohio versus the hot spots of Stanford and MIT. XD: I think it's a greater challenge. We go through a lot more than most people realize. When you're starting some technology initiative around a place like Stanford, I

think there are a lot of things people have access to that they don't really appreciate.

SM: I also really like the approach you took to start the business. You seem to have a real flair for writing grants – and winning them. Funding is typically the bottleneck for highly innovative R&D companies like yours. But you have maneuvered very well on that front. XD: Right now we have $20 million from government projects as grants or loans and $40 million from four different venture firms. That gives us a total of $60 million. I think that number is good enough to let us take off.

SM: Wonderful, and congratulations. Please keep me posted on how you progress.

Cross-Domain Innovators

Barriers to Innovation

A decade ago I listened to Richard Newton, the former dean of engineering at the University of California, Berkeley, and a lifelong champion of innovation, at a private function in Silicon Valley. One of the things he said has stayed with me: Innovation opportunities going forward will be at the cusps of once disparate disciplines – biology and computer science, information technology and healthcare, semiconductors and medicine.

Richard Newton passed away from pancreatic cancer two years ago, but major efforts are under way at top universities to explore these opportunities at the cusp. MIT set up a new department for brain and cognitive science research right across from the Computer Sciences and Artificial Intelligence Laboratory (CSAIL) to help scientists straddle different fields. The entire field of computational biology, a field that did not exist in the mid-1990s, has now become a major force in critical areas like cancer research. My friend Carlo Maley, who could not find an adviser at MIT for this field in 1995, today has his own lab at the Wistar Institute in Philadelphia.

Unfortunately though, while scientists are experiencing strong support, entrepreneurs attempting to work at the cusp of different industries are rarely lent a hand. It is worth exploring why.

One of the fields close to Newton's heart was electronic design automation. Eventually, as Moore's Law drove semiconductors to increasingly miniature sizes while packing in more and more functionality, it became extremely challenging to manufacture these chips. Yield started declining. Experts from both industries realized that chip design and semiconductor manufacturing, which were previously segregated, needed to come together. If yield could be improved by one percentage point, the savings involved would be $50 million or more.

So a new field opened up that came to be known as design for manufacturability (DFM). But despite its potential impact on the future of electronics, it remains an esoteric field with a remarkably small number of people who understand the intricacies of both chip design and fabrication.

Yes, you do find some technologists who grasp the cusp. But then you also need businesspeople and investors to play their parts for innovation to successfully reach the market. In volume one of *Entrepreneur Journeys*, I discussed H. P. Michelet and his water desalination company, ERI, who battled to bring esoteric innovation to market through a harrowing 13-year struggle. But many more entrepreneurs and venture capitalists get excited about Web 2.0 than about such cusp ventures. Why? Because they are extremely complex, requiring a level of technical depth, intellectual horsepower, business savvy, and an appetite for risk that is rare in today's technology industry. Spreadsheet jockeying by some MBAs with little real instinct for innovation is not enough.

To be fair, in some fields of technology, cusp businesses have been easier to commercialize. FireEye chief executive Ashar Aziz talks enthusiastically about his innovation at the cusp of computing, security, and networking. "What we do is a combination of very deep system-level work in virtualization and operating systems, as well as network-level packet processing," Aziz says.

And he loses no sleep worrying over the thought that some giants might come in and replicate what he has done. "Large companies are very busy doing release 6.5 of the previous 6.0 version,"

Aziz says. “They can’t take many different things and put them together. They don’t have the varied domain expertise to put it all together.”

While FireEye is funded by Sequoia Capital, the lack of domain expertise to work with cross-domain innovation is a real issue in most venture firms. The level of dedication it takes an early-stage investor to understand three different fields and synthesize the learning in terms of technology, business models, go-to-market strategy, and people is rare in today’s Valley and altogether absent elsewhere in the world.

This raises a major question: How does cross-domain innovation get to market? Contrary to Web 2.0 ventures, high-impact cusp ventures require real investment up front to assemble cross-domain teams and fund extensive R&D. The gestation periods are longer, but so are the impact and the returns.

To successfully address healthcare administration challenges, for example, some experts believe that one of the best technologies for claims processing is natural language processing, an artificial intelligence (AI) discipline. The small company CodeRyte aims to crack this code, but knowledge about AI is by and large absent in healthcare. Venrock Capital, a Silicon Valley venture firm, is backing CodeRyte and has developed expertise in healthcare IT.

Similar dynamics prevail in energy. Much interest has been generated in upgrading America’s grid infrastructure, but it is a complicated undertaking requiring knowledge of technology, business models, and policy. The intelligent-grid company eMeter seems up to the task. Their investor, Foundation Capital, has invested millions in this and other cleantech ventures. Expertise also exists in Vinod Khosla’s firm, Khosla Ventures, in other areas of cleantech.

But VC firms that have really dug deep into cross-domain issues are few and far between. Most firms have a cleantech partner, who is essentially a reincarnated software investor with superficial knowledge of water, energy, or battery technology – to say nothing of healthcare IT or education technology.

So how do those entrepreneurs audacious enough to take on planet-scale problems get off the ground? Much as I advocate bootstrapping to entrepreneurs looking for control over their destiny, I cannot help but worry about the future of big, bold, groundbreaking ideas.

Which VC is going to fund a PowerPoint presentation about an “edutainment” franchise to rival Harry Potter in its popularity, Bill Gates in its wealth creation, and Google in its impact on the world? Which VC is going to give the green light, allowing a dream to advance toward reality?

Ashar Aziz, FireEye

Ashar Aziz is one of those rare entrepreneurs who received a $100 million education during his first startup. For his second attempt, he has managed to pull a cross-domain venture together. Ashar highlights the entry barrier created against competition when you assemble cross-domain expertise within one company. The cascading set of competitive advantages then includes technology, business models, financing, and talent across domains.

SM: To start, take us back to where your story begins. AA: My story begins in Pakistan. I was born in Karachi and grew up in Islamabad. I still maintain a residence in that part of the world. When I was 13, one of my cousins told me I was smart and that there was a technical school out there called MIT, which was the best in the world. At the time I didn't know how to get there, but I decided to pursue that opportunity. The way I went about it was a bit odd.

I didn't know the address, so I went to the American Center, where they told me I couldn't go there for undergraduate, only grad school. That was completely untrue. But there was a scholarship for a school in Turkey, and I heard if you went there then you could go to MIT. So I decided to try for that scholarship, and I ended up winning it. And true enough, there were two people who went to MIT from that school every year as transfer students. I managed to be one of those two, and I transferred to MIT as a junior.

SM: Very entrepreneurial of you. AA: Yes, my role models were superheroes and entrepreneurs like Ironman. I always wanted to build something and make a difference. I didn't know any better way to do that than by being an entrepreneur. A technologist can either work somewhere or can build something that can have a bigger impact. After I graduated from MIT, I came here to the Valley.

SM: Where did you work? AA: I ended up working for a small startup, making disk controllers. I then went to Berkeley for grad school and worked for a little company in Berkeley that did Unix and networking. That's how I got into Sun Microsystems. It was great for me because there were a lot of smart people at Sun, and I learned a lot from them. They had the smartest people in the Valley.

I didn't know how to become the entrepreneur I wanted to be, but it did seem to me that I would need some credibility to get there. I decided to pursue the highest technical level possible at Sun, which at the time was "distinguished engineer." I made that after about four or five years at Sun.

But five years in, I was still spending a lot of time thinking about the idea of getting a business going. I had a lot of thoughts, but I lacked the confidence to pursue my dreams. I didn't know how to execute. The confidence to go pursue something when you haven't seen people around you do it can be a difficult thing to obtain.

SM: How did you finally gain the confidence to launch your startup? AA: It was completely fortuitous how I finally got off the ground. One of my VPs at Sun became a venture

capitalist, and I had a meeting with him in 1998. At that time I felt the computing infrastructure was very inefficient; it was manual, labor-intensive, and not optimized. I wanted to create a virtualized infrastructure. Terraspring was started over this conversation with him, explaining my concerns. I didn't even have a business plan. He called me afterwards and told me he enjoyed our conversation, and that if I wanted to build a business around it, he would fund it.

SM: That was your seed capital? AA: That's what I used for seed capital. I recruited two engineers from Sun who were working with me at the time, and we started to build the vision, still without a business plan.

SM: How much money did he give you? AA: He gave us $500,000. In addition to that, we were EIRs [entrepreneurs-in-residence] at Mohr Davidow Ventures. We worked there for four months, refining the technology, business idea, and go-to-market strategy. The trend at the time was services, so we started out building a next-generation Exodus. We were planning on building intelligent datacenters, not just the technology to power them.

SM: All of the virtualization you were planning on doing would have been executed in your own datacenters? AA: Correct. We weren't going to provide existing datacenters with the technology. We were overly ambitious because that's how people thought at that time. But the technology was really awesome. Along the way not only did I raise about $70 million in further investments with folks like Hewlett-Packard, EMC, and Accel Partners, but we were at the executive level of all of those companies – we were building the virtualized platform that was recognized as the platform of the future.

The vision was right; we just did it too early. This technology just started to get used in 2008. As luck would have it, the market crashed in 2001, and we had to salvage what we could. We decided to make it a software company, but even there we had problems making the transition from datacenter into software. It was painful – we had to let go of people.

We had a very large acquisition offer from one of my investors. But we turned it down, which was a mistake. It was more of the hubris of 2000. They gave me a $30 million software deal our first year, which was just awesome. So now we had $30 million in revenue – add that to the investments received, and we went through $100 million in my first startup. That was my $100-million education.

SM: A $100-million education – wow! You better have learned the lessons very well! AA: You can't get that at Harvard or Stanford! The interesting thing wasn't necessarily learning what to do; rather, it was learning what not to do.

SM: Besides biting off too much, what are some of the other things on your list of "what not to do"? AA: Cash. I was not the CEO, I was the CTO at the time, so I can't take full blame or credit, but the lesson is this: cash, cash, cash. We went through a lot of cash. We were spending $5 million a month pre-revenue. It hurts me to think about it because I raised that money.

That's part of the lesson I want to carry on. You have to be very, very tight when you spend money. The only time you do an expense increase is when it's absolutely necessary.

In the old days you raised a lot of money, and then you spent it.

SM: That brand of entrepreneurship is gone. AA: It is gone now, but it was possible then. In fact, people expected it. So we had a tough time, but then Sun came in and acquired the company. It wasn't the best outcome for the employees or the investors because it was 2002, the bottom of the bust. But I was able to walk away knowing the vision was right. The mistake was biting off too much and requiring too much capital to get to stage one. The higher the capital intensity, the greater the risk of ultimate failure.

If you're going to build a business, build it with the lowest level of capital intensity; get into the revenue stage with a minimal amount of cash.

You can do three startups with $100 million, which is what's so painful about my first startup.

SM: Your point about capital intensity is very important. First-time entrepreneurs, in my opinion, should not take on capital-intensive projects. They don't know how to manage capital. AA: No, they don't. They should be given a constraint: "Here's $5 million or $10 million – let's see what you can do with that."

SM: Over the course of time – they should not even get that in one shot. AA: Definitely, over time. Take two years to spend the money and get to a proof of concept, a product with a revenue stream, and a market validation. That's what needs to be done.

SM: That is a discipline that entrepreneurs need to put on themselves. If they do, they will maintain control of their company. It is a milestone-based, disciplined approach. AA: That will maximize the chance for success. If you're in a place where you need another $20 million to get to the next stage, then things become very hard. I learned that lesson the hard way.

SM: What are the positives you took from the first venture? AA: I'm gratified now to see that our idea wasn't stupid. When the company was sold, I sent a note to all of my investors thanking them for their support. I told them that whether we were the ones doing it or not, I firmly believed our method was how computing was going to happen in the future. And I see that happening now.

SM: Another point we should emphasize is that timing is a critical issue for startups. AA:

A vision is great to have, but you get no brownie points for being too early to market.

For an entrepreneur, it's tricky to balance timing. You can be too early and the market is not there, or too late when there are too many competitors. There is a strike window, but it's not obvious where that strike window is.

SM: You need a lot of luck to hit it just right within that window. AA: It's like landing a fighter jet on an aircraft carrier; the landing strip is very tiny and moving all over the place.

SM: Have you developed any mechanisms to identify that window of opportunity? AA: Here is my very generic advice for entrepreneurship, which you can apply to any domain. Generally, an entrepreneur is looking for opportunities. The question to ask is why are incumbents not taking advantage of the opportunity? If there is food at the table, why are the bigger guys not eating it?

My philosophy is that problems create opportunities. Look for problems. There are plenty of problems that already have solutions, so the question is what kind of problems should you be looking for? The answer is that you're looking for new problems. New problems exist where there's change or discontinuity. And new problems create opportunities, but they only exist in a small window. You have to strike at that window. This is where luck is on the side of the entrepreneur. The incumbents are poorly positioned to target something moving and in flux. Gaps open in the market, but incumbents aren't nimble enough to jump into that gap because it's not large enough for them yet. Entrepreneurs must have a reason to believe that the gap will get bigger and then jump in.

This is one of the problems when you're a technical entrepreneur.

> ***People design something really cool and then think, "I wonder if I can make a company around this?" That is absolutely the wrong way to think. Don't approach it from a design aspect, but rather from a problem aspect.***

SM: This is something I have experienced a lot in my consulting life. Somehow Silicon Valley is great at coming up with solutions that are looking for problems. Of course, they have no idea what the problem is! AA: That's a great way to describe it. I also like to point out that the problem has to be the right size. It can't be so large that the big players are already taking it on, but if it's too small, it won't sustain a business.

SM: Market discontinuity is vital in this aspect because it drives the timing aspect and keeps new problems coming. AA: That's when to strike. When it's coming around, jump in. Before you make the jump, just make sure the problem size is large enough to sustain a growth period.

SM: The solution also must be architected to take advantage of the existing parameters of the world. AA: Absolutely! You're not living on Mars! It has to fit into something people are used to doing. You have to become part of an ecosystem, otherwise you're expecting the stars to align for you, and that seldom happens.

SM: How do you, as an entrepreneur, follow your own advice? How do you pursue new opportunities? AA: I actually maintain a notebook of ideas. I develop multiple ideas in parallel in that notebook. FireEye is one of the ideas from that notebook. The ideas are written there so I can go back and read how this was developed. I had three other ideas developing at the same time, and they were good ideas as well. In fact, a couple of them have been launched by other entrepreneurs and were funded.

SM: If it is a good idea, somebody else must have thought about it also! AA: Exactly! There are a lot of bright people out there. When I was trying to juggle the sets of problems that were emerging and trying to quantify the change that I could capitalize on, the question I asked

was this:

> ***"What is my unfair advantage in this picture? What skills do I have, what domain expertise or marketplace knowledge do I have, or what is it that I bring to the table that allows me to have an unfair advantage over others?"***

I applied that filter to all of the ideas in my notebook, and I picked this one.

With this startup it's a combination of virtualization, which I did in my previous startup, and my work at Sun, which was network security. I knew a lot about both areas. I combined them to solve a problem that I knew was going to be huge – the current malware problem. There are multibillion-dollar TAMs around the problem of getting infected via the Internet. Anti-virus and anti-spam products do a poor job of protecting against malware via the Internet.

From the perspective of my previous startup, FireEye is a complete domain shift. Going from a virtualized computing infrastructure to security and deep malware control is a big jump. The interesting part is that while the market is different, I've been able to leverage my domain knowledge in operating systems, virtualization, and networking. That gave me the unfair advantage to come up with the blueprint for this unique approach.

SM: You had a unique combination of domain expertise and technical expertise, which is rare. AA: It probably is, and it's what gave me the unfair advantage.

> ***There are a lot of things out there you can do as an entrepreneur, but when somebody else comes into the picture, you have to figure out a way to out-execute them.***

That's where the unfair advantage principle is useful.

SM: Oftentimes when you straddle different domains, you develop a greater "unfair advantage" because most people spend their entire careers in one domain. AA: Bingo! This is a great point because multiple-domain disciplines are hard to put together, especially in a large company. Large companies are very busy doing release 6.5 of the previous 6.0 version. They can't take many different things and put them together. They don't have the varied domain expertise to put it all together.

SM: Not to mention they are not cross-functional. AA: They aren't designed that way. They talk about it – it's a nice buzzword – but they're not designed that way. A startup is uniquely designed to pull different people from varied backgrounds and build something that straddles domains.

What we do is a combination of very deep system-level work in virtualization and operating systems, as well as network-level packet processing. In the industry, these are two very different things. You may have a company like 3Leaf, which is very deep into systems but doesn't have a network-level device. You may also have an IPS that's doing header processing. Combining those two in a single company is very hard. I lose no sleep over the thought that these giants will come in and replicate what I've done.

SM: Let's talk about the specifics of FireEye. What is the marketplace like? AA: When I started FireEye, I was looking for the boundary of change. I was really looking for a big problem, and getting infected by malware via the Internet is a global problem. I read a lot of literature

about how malware could evolve and make traditional defenses obsolete. The blueprint for the bad guys was out there on the Web, but there was no blueprint for the defenders.

In 2004, it was the Internet of random scaling worms – Blaster and others infected millions of systems. As nasty as those were, the reality is they were toys written by children. If you look at the concept of infection and implantation of software without the owner's permission or awareness, it could create complete chaos.

Malware didn't have a business purpose in 2004. Its purpose was to make the kids who were writing it happy. However, their tools were very powerful for thieves. If I'm a thief, I have two motives: first, I want to make money, and second, I don't want to get caught. The thief is working through malicious software, so evasion must be a very important part of software evolution. The challenge I had was that these issues were building in 2004, but they weren't there yet. I had to start building with the belief that these types of systems would get there. Our business was a preemptive
strike. It was important for both cybercrime and cyberwarfare, which is something I think we'll see in the future. Both elements are still on the drawing boards.

Cybercrime and the ability to make money come with payloads. The old malware was just like a missile, but there was no payload attached. Now malware comes with payloads that can download key loggers, steal your credit cards, steal your company's intellectual property, or steal your data. It becomes something you can monetize. Today there are billions of dollars moving around in the underground economy, which is very scary. That means cyber criminals have a large cash cow and thus greater incentive to avoid getting caught.

That was the genesis of FireEye. The blueprint to answer this challenge needed to be created from scratch, which is what I spent the first six months of my time in my living room doing. It was a tough problem because when malware comes across the wire, if you go away from signature-based solutions, which is pattern matching, you don't know what you're looking for. It's going in 100+ gigabit traffic flows, and you don't know what you're looking for, but you have to find it every time, and you cannot have false alerts. That's a very tough problem.

SM: Tell me how you solved that problem. AA: The ultimate solution was actually quite simple. When you're building a detector, you have to be good with both false positives and false negatives. If you're building an alarm system, you don't want the motion detector to go off when there's a fly in the room, but you do want it to go off when there's a thief in the room. The problem is that a thief can be very stealthy. If the thief starts to look like a fly, or if the thief moves very slowly, how do you catch that thief?

The only way to do that is to have a very sensitive detector. But the problem with a detector like that is it will trip constantly. We applied that principle as a subsystem in our product. We built the detector as a front-end capture system. It's not the entire system. We intentionally built it to be an ultra-sensitive detector. If there's a fly, it will capture the fly and give it to another system to detect what that fly is.

The goal of the front end is to not miss. Traditional heuristic systems try to minimize false alerts; we minimize missed attacks. We take all of the captures from the front end, which will include a lot of false alerts, and pass them to a set of virtual machines. They act as virtual victim machines. They pretend to be like the real system. The captures from the front end, which could be bullets on the wire, are transparently shot at the VMs. If the VM gets infected, then we know it's a bullet. It's almost like a food tester. That's the phase where we get rid of all the false alerts.

SM: Quite elegant and simple. I love that aspect of it. AA: I can describe it in two minutes to a CIO. There was a lot of hard work from the team that went in to put all of this technology together. The implementation and efficiency of managing that system is what we've focused on for the past three years.

The Web is the most prolific source of malware today. One of the things that happened is the infection vector of malware shifted over the course of a year or two while I was building this technology. Over the past year and a half, we figured out that it wasn't coming in over vulnerabilities on the operating system – it was coming in over the Web. We shifted and adapted our platform to work with malware as it was coming in over a malicious Web page, affecting your browser, as opposed to coming in and affecting the operating system through RPC.

That product is now on the market. I just deployed it this week at two or three of the largest companies in the Bay Area. Almost as soon as we deployed them, alerts started lighting up like a Christmas tree.

SM: Are corporations now feeling the pain? Is it real? AA: The evasive nature of the problem is part of my marketing challenge. Old, noisy malware rang a lot of bells, but it didn't do much damage. Today, malware doesn't ring many bells, but it does a lot of damage. They are thieves, and they are trying to be as quiet as possible.

SM: Could I summarize your challenge as solving perception versus solving pain? AA: That's a very good way to describe it. There are some proactive people who understand there's a gap. As I speak to savvier computer security organizations, I see they're very aware of this. Google did a study on their content cache and found that a substantial portion of their cache is malicious. That means the entire Internet is a gigantic minefield.

SM: How did they do that test? AA: They ran a pre-filtering algorithm similar to what I did in phase 1, only they were doing it in batch mode. They looked for suspicious pages, ran them in VMs, and were able to identify the malicious logic that way. They have the advantage that the pages are cached, not on the wire. That allows them to analyze as they need to, and they can see the true depth of infection on the Web.

SM: Are you starting to see case studies you can actually share? AA: We'll have some very soon. Two days ago I installed in another large company, and the sensors lit up while I was still there. One of their finance systems was infected and under remote control from the outside. They had to immediately shut off the switchboard – they're a public company. That's a pretty significant example of the type of impact we can have on an organization. Before we came, there were no indications of anything wrong with their systems, but once we installed, we were immediately able to show them where the infections were.

SM: You are picking pilot projects at the heart of the company – a great way to break through in this market. AA: Intellectually, it's a very easy argument to make. I can make that argument to Wall Street or anyone. If we bring the system in, we will actually show the real exposure.

SM: This is a great effort. The Bay Area used to be chock-full of such real innovation, and then we fell into the foo-foo stage. AA: The technology is what inspired me. It was very

interesting and challenging to build. Given my background, I had to do a technology project; otherwise, I wouldn't be using my advantage.

SM: Congratulations. I'll keep an eye on your work!

Healing Healthcare

One of the darkest of budget black holes in the US is the $250 billion a year it spends on healthcare administration, which manages the information flow between providers, patients, and insurers. These archaic systems and processes lead to myriad disputes, paper pushing, hours of wasted phone calls, and deep injustice. In lieu of this, a number of startups are attempting to streamline healthcare administration and reduce costs.

For instance, athenahealth offers a software-based subscription service to doctors' offices to help collect reimbursements from insurance companies. Based in Watertown, Massachusetts, athenahealth processes a billion claims per quarter, taking a percentage of the collections. No up-front fee; no setup charges. All insurance company rules are codified into athenahealth's system, making the reimbursement filing fast and seamless. Doctors see the tangible benefit as collection times drop from 75 to 45 days.

They serve nearly 12,000 physicians, managing over $2 billion a year in revenues on their behalf. The company went public in 2007 and generated over $100 million in revenue. In 2008, athenahealth did over $139 million, and in 2009, it crossed $170 million – a successful, high-growth company by all counts.

Bryan Roberts of Venrock Capital, an early investor in athenahealth, estimates the total healthcare claims processing market to be $10 billion. A market fruitful enough to nourish at least 100 further players. VCs should be scrambling to fund these companies just as they've done in the Web 2.0 and software-as-a-service sectors. After all, how many $10 billion market opportunities are there?

And this is not the only opportunity in the healthcare sector.

Dr. Jason Hwang, co-author of Clayton Christensen's new book, *The Innovator's Prescription*, is excited about Franklin, Tennessee–based Healthways. The company is a technology-
enabled disease management service provider that monitors and helps improve patient health. Major employers like General Electric use the Healthways service, paying the company a fixed annual fee to take care of employees who have certain costly illnesses. Healthways had annual revenues of $750 million in 2008, serving nearly 29 million patients.

Dr. Hwang says there are also opportunities in disease-monitoring devices, such as glucose monitors for diabetic patients. Most other diseases, however, have not seen the level of success in empowering patients and caregivers through self-administrated treatment. In fact, the Healthways story points to a massive opportunity in both innovation and job creation. Patient monitoring and treatment supervision on a regular basis is key to preventing major diseases and staving off expensive healthcare bills. A large-scale adoption of the Healthways model could help foster the growth of companies that train medical assistants to administer care.

Today's businesses models, however, do not support such ongoing care, except in the rare cases where the insurer and provider are one and the same. Kaiser and Geisinger are two examples of the vertically-integrated model, wherein they have the incentive to focus on prevention versus cure. Thus, a reengineering of the business model is also necessary to advance the system, and perhaps some smart policy here would really quicken the pace of transformation.

Here's an example that will resonate with the hundreds and thousands of Web 2.0

entrepreneurs out there: Cambridge, Massachusetts–based PatientsLikeMe was founded in 2004 by three MIT engineers who had personal experience with Lou Gehrig's disease. They decided to create an Internet community of patients, doctors, and organizations for various diseases. Such communities hold immense promise for the future of healthcare; pharmaceutical companies can directly communicate with patients and coordinate clinical trials, while patients can access support groups to share their experiences. These pharmaceutical companies have enormous advertising budgets (north of $15 billion a year), and professionally run communities that focus deeply on the ecosystem of specific diseases can be attractive, highly targeted venues for them to sponsor.

As discussed in my *Vision India 2020* series, there is no shortage of opportunities beyond the US to make healthcare accessible in remote populations. My thesis follows that the number of professionals administering healthcare must extend beyond certified medical doctors to a broader population of pharmacists and medical assistants using technology solutions like Expert Systems.

Overall, the healthcare industry is a significant problem area that encapsulates numerous dormant opportunities for both entrepreneurs and venture capitalists. And yes, healthcare needs to create a bubble comparable to the dot-com, telecom, Web 2.0, and greentech bubbles we've experienced in the last decade. Those bubbles drew attention, energy, and investment, creating companies, jobs, and wealth.

So let's blow it up!

Jonathan Bush, athenahealth

Jonathan Bush has taken the healthcare claims-payment bull by the horns to build an excellent company. But to arrive at the right problem that would support a substantial enterprise was not a direct path. Several suboptimal ideas powered through a market validation phase until Jonathan found the one that really resonated.

SM: Jonathan, let's start with your background – your personal story. JB: I grew up in New York City. Medicine was the only career that nobody had done in my family, so I figured that would be a good career for me. I could be the best in my family in my profession, and I wouldn't have to be all that bright to do so!

Actually, I've always been interested in healthcare – it's a place where you can do well and do good. But when I got to college, it occurred to me that you had to know a lot of science to be able to go to medical school, and I wasn't that good at it. It just wasn't my natural fit; I'm more of a social creature, an idea person.

In an effort to learn more about medicine, I got a job driving an ambulance in New Orleans. I found that while the doctors I ran into were incredibly competent, they were bored from time to time. They'd learned an enormous amount of information, and now that they knew it, their only calling in life was to continue delivering against that same body of information. It seemed that the connective tissue between patients and the very bright and capable doctors was really poor. It was a disaster.

I figured that no matter how bad I was, I could find a way to do better. That really got me excited about the delivery system over the actual science of medicine. I wanted to be the innovator of a functional delivery system. At first I thought I was going to start an ambulance company and that the ambulances would do more in the field to reduce unnecessary emergency room admissions, but there was already a company rolling up ambulance companies, and I didn't think I could play at the same time. So we decided we'd try to manage practices ourselves. Athenahealth actually started as Athena Women's Health, and we acquired an interest in a women's health practice.

SM: So other than driving an ambulance, was athenahealth your first job? JB: It was my first job out of business school. I had worked for the George Bush campaign in 1988, I drove an ambulance, and I was a combat medic in the Army. Then I was a consultant at Booz Allan Hamilton and worked at my dad's investment firm, but I never did any one of those jobs for more than two years. It was an awkward ramble through those parts of life.

SM: When you were rambling through those possibilities, did you have something of the nature of athenahealth, no matter how nebulous, in your vision? JB: Yes. I wanted to do something where I was at the end of the food chain. I wanted to be touching actual patients. I didn't want to be selling tools or capital. That's about the only thing I really knew at the time. I remember doing informational interviews, looking for a job, and I spoke to a McKinsey partner. I asked him if McKinsey had an actual healthcare practice, and he said, "Of course, it's actually quite strong. We work for Johnson & Johnson and other companies like that."

"No," I said, "I mean actual healthcare where there are doctors and patients."

"We have a not-for-profit," he replied. "You can do pro bono work in your spare time for hospitals."

I found it very odd that the formal practice of McKinsey, that you could build your career on, was selling the construction of drugs and devices, but if you wanted to help with the delivery, it had to be done pro bono. That got me turned around. At one level I thought it was ridiculous, and at another I thought it was wonderful because here was my opportunity.

SM: What year are you talking about? JB: That was my last year of college, so probably around 1993.

SM: Bring me to the genesis of athenahealth. What year was it, what was going on in the marketplace, and what happened in your head that led you to athenahealth? JB: I really wanted to do something entrepreneurial. I didn't want anybody to say that I was given it all because I had a wonderfully sheltered and supported childhood. The idea of starting my own company and having it turn into something seemed like a good way to make a man out of myself, or not.

SM: OK, so you had come to the point at which you were going to do something entrepreneurial, healthcare related, and close to the doctor/patient ecosystem, correct? JB: Right. The closest I got to that doctor/patient ecosystem was at Booz Allen Hamilton, where they were starting a healthcare strategy practice at the same time I was looking around for a first job, and that sounded like a good fit. I wanted to find some great healthcare leader and carry his bag and write his or her thank you notes. Of course I couldn't find it, but Booz Allen gave me a great opportunity to learn about the space, so I spent a couple years there.

I did a ton of work for health plans that wanted to get directly into the delivery of healthcare. They wanted to recruit physicians onto their side, a bit like Kaiser. I thought it was interesting and exciting, but it didn't work.

But I had a buddy at Booz Allen named Todd Park, and I figured we could do it.

> ***We started talking about it one night when all the cubicles were empty. We started talking about how it could be done properly, how the insurance companies weren't doing it right.***

They needed better information technology and a unique service approach. This was also right when Starbucks was exploding, and we loved how Schultz had been a barista and had gotten every single bit of the service right. You never saw anyone do that in healthcare.

So we decided to find a sector of healthcare that had a retail component but was complicated enough that really good information technology would help. We ended up with obstetrics/gynecology because there were deliveries, surgeries, but also because women choose their own ob-gyn. You often get handed an oncologist or cardiologist by your primary care doctor, but you choose your ob-gyn. We liked that because a better service experience would lead to more market share.

That's how we started. I left Booz Allen and went to business school. I spent a year and a half writing a business plan for a women's health practice management company that was going to revolutionize birth. We were going to treat birth as a wonderful, healthy experience during which

you sometimes get ill, as opposed to an illness, which is how most American women get treated. We got very excited by it, we built a unique clinical model, we validated it with research, and we found the people doing the research and got them to be our first partners.

It was very exciting until we realized we couldn't make payroll because we had to file those bloody medical claims. Each needed its own unique footprint of various kinds of information, and it changed all the time. All kinds of bureaucratic garbage got in our way. We ended up building a Web site internally to try and keep track of what was going on in our own clinics' front desks. That was the actual genesis of athenahealth.

I'll never forget going around trying to raise money for a women's health clinic at a $5 million pre-money valuation. A VC from Texas offered me $11 million for the rights to athenanet, so I figured that meant that either athenanet was worth a lot more than I thought, or that my company was worth negative $6 million. That was a wake-up call. Todd and I went through a very painful series of conversations where we realized that some of what we were doing was so far before its time that it wouldn't happen, but that some of what we were doing was just enough before its time that it just might take hold.

SM: What year was that? JB: That was in 1999.

SM: The Internet was already starting to gain a foothold. What did athenanet do that the VC found so appealing? JB: I don't know what he saw in it, but it was unique. It was Web native, which meant it would run on a modem connection. In 1999, wide-scale broadband was not available. This thing worked leanly and quickly. It kept track of the little details that the hourly workers, who make most of the decisions in medical practice, control – and in very simple terms. It didn't even do billing at the time; it just kept track of what you could bill and what information you needed to eventually bill.

SM: You essentially built a patient information system. JB: Exactly. We had plans to eventually start billing, and by 1999 we were well on our way down that route. In early 1999, we made the decision to stay in business as a management service, but we were going to narrow our management service for a while so that it would only be claims-related. We also decided to broaden our target market to any doctor.

SM: Is that the thesis on which you raised your venture funding? JB: Todd went out and looked for doctors while I went out and looked for venture funding. By October of that year, we had more VCs than we needed and five customers. The first customer went live on January 3, 2000. On a side note, don't start an Internet company on Y2K day. That was a mistake.

SM: When you signed up your first customers, how were you charging them? JB: We owned an interest in two medical practices. In a way, you could say our first two customers were ourselves, whom I refer to as our alpha customers. We charged them a percentage of profits. The other three were our beta customers, whom we charged a percentage of revenues because we weren't in charge of how many people they hired and what they paid them.

SM: Your value proposition was that you would retrieve their claims? JB: Correct. We wanted 3% of what we retrieved for them. We would provide them the system, training, and do all the work associated with getting them paid.

SM: Help me understand the way you designed the system through the years. Walk me through the innovation. JB: The original vision of the company was management infrastructure that makes healthcare work the way it should. When we changed, it became information infrastructure that helps healthcare work the way it should. The idea was to work towards a national utility that could be used to innovate healthcare.

Another key aspect was to build for the public good. We tried to have all our software development work be on projects that benefited everyone on the network.

> ***There are a lot of software companies that boxed themselves out of existence by building unique feature upon unique feature for their best customers. Soon their software was unrecognizable.***

SM: What are some examples of software development that you did that eventually proliferated to your entire customer base? JB: Rules development. Every time a claim is denied for any one doctor, it goes through a check. If it looks like a candidate for rules development, analysts get ahold of that claim and really dig in until they get to a root cause. Once they have the root cause, they work with programmers to build a change into athenanet that prevents anybody from ever getting that denial again.

There are now 40 million different scenarios in which a rule such as the one I just described will correct some hourly medical office worker – sometimes before the patient has even arrived – and get them back on track. It may only be relevant to one insurance company, but it applies to every doctor who sees patients from that insurance company. Little by little, those rules accumulate into a very elaborate national knowledge resource.

SM: Your rules enhancement is entirely hand-coded? JB: That is correct. It involves business trips out to health plan headquarters, statistical analysis, and some automated algorithms that look for similar claims. If we can find a range of similar claims that have all been denied, then perhaps there's something deeper we can explore.

SM: But you still have a master database of rules against which physicians can file their claims, and from the sounds of it, you have a database that is very well cleaned. JB: That is exactly right. Physicians don't actually file their claims; they just do their work. The rules engine is sitting under the surface of every step. It sits inside the scheduling module, so if you make an appointment that requires an authorization and we find that you don't have an authorization in your authorization file, it will alert you right then.

SM: Help me understand the interface between you and the practice management system. Are you the entire practice management system for the physician at this point? JB: That is correct. We handle registration, scheduling, check-in, and check-out. There are two levels of service: collector and clinical. If you have both, then everything that happens in the exam room and all the orders, results, follow-up with the laboratories, and posting of the results that come back from the laboratories, including those by fax, are covered. We're the only healthcare IT company that deals with the portion of healthcare that is not online. That turns out to be most of healthcare.

A doctor who just spent $50,000 on electronic medical records has not changed the fact that every laboratory he or she uses has not gone and bought their EMR. Thus all the results they

receive will come in via fax machine. That puts them in an awkward predicament because now someone on their staff has to sit there and digitize it. We actually forward the practice's fax line to our data center and automate those connections as part of the service in the background. We layer on optical character recognition and queuing theory to approximate the accuracy and speed of an electronic connection. What we have emerging in the background, without anyone paying for it directly, is the first national health information backbone.

SM: What kind of market penetration do you have? JB: From the physician point of view, we have about 2% of the market share. There are 700,000 physicians in the US – 600,000 who we believe practice medicine. We have about 13,000 MDs and 19,000 medical providers. We can send a claim electronically to 85%–87% of insurance companies, which is more than anyone else. We can receive remittance electronically from about 75% of insurance companies. And we can receive results from 15% of the nation's labs. The rest we have to go out and handle via a queue of PDF images that come in over the fax line. Little by little, those percentages have been going up every year.

SM: You have the beginnings of a very efficient national healthcare system. Now all we need is the political will to make healthcare an efficient system. Let's explore your sales model. JB: Our sales model is based on direct sales forces. There's one for small practices: 40% of practices are in groups of three doctors or fewer. Then we have a small enterprise group that handles the large hospital chains and national accounts. In all cases, we sign a contract and set up each practice on the network ourselves. In the small practices that can happen largely online, without anybody showing up at a small practice office.

The biggest obstacle to scaling at this point is that nobody has heard of us. That's why I'm so excited to talk with you and go on shows like CNBC or anyone else who'll get the name of athenahealth in front of people. Most physicians don't know there is such a thing as a software-enabled service that does billing and medical records over the Web for a fraction of what they expect the cost to be. Once we've convinced them we can do what we claim, it's very easy to sell to them.

SM: From an innovation standpoint, what are the other pieces of the dysfunctional healthcare system, besides billing and claims processing, that are on your radar? JB: The first piece of the supply chain is the lifecycle of the medical claim – we have that well in hand. The next piece is the lifecycle of a physician's order. A physician can order another physician's time, or a prescription, or a blood test. Those supply chains are out of control. Most doctors have no idea if their patients go and get the things they order, and many times they never get the results back, so they can never follow up with their patients.

A recent study found that 35% of the women who had annual exams and had abnormal Pap smears never found out.

SM: That is scary. JB: It is. The Institute of Medicine has documented these kinds of error rates for years, and it's devastating because the doctor still gets paid. It's what a doctor would refer to as an unfunded mandate. We think by automating the supply chain we can save the doctor funding and fill the social gap. Over time, that may make the doctor more money because people won't be able to sue as easily.

The third supply chain is the lifecycle of patient interaction. A huge amount of unfunded work for a doctor comes in phone calls from patients asking questions, trying to change their appointments, getting directions to the office, or asking questions because they don't understand their bill. Most patients are frustrated by their inability to communicate with a doctor; most doctors are frustrated with the cost and confusion of being available. By the end of the year, we'll roll out a patient communication service to improve those issues.

SM: Do you plan to implement technologies like knowledge bases, automated Web self-services, and other similar systems? JB: Bingo. The first thing you do in healthcare is solve existing problems. Once you have the solution implemented, then you can start asking how to improve the solution, and you do that on your own time. All doctors care about is that we'll answer the phone on the first ring and they won't lose as many appointments. After that, we'll have to illustrate that many patients would rather just hit a Web site to change their appointments or look up lab results themselves.

SM: In many ways the technological innovation we are talking about has been around for a long time. JB: It definitely has, but it hasn't been packaged in a way that makes the doctor more money.

SM: It has not been applied in the context of the healthcare industry. JB: That's right. I think the primary reason for that is the packaging. Lots of people put out technology, and they even give it away on the pretense of making things better for society. But they ask doctors to use it at their own expense, which will cost the doctors time without helping them make more money. That's no way to do business.

Doctors are business-savvy. They're good men and women, but at the end of the day, they need to make money. They're in business.

We talk about the plutonium sneakers at athenahealth. The plutonium sneakers are the hospital that says, "We have access to all these plutonium sneakers, and in order to win our physicians' loyalty, we're going to give them out to all the doctors in our community." The CEO then sees the doctors and says, "Hey, doctor, I noticed you're not wearing your free sneakers we gave out. Why?" And the doctor says, "They have plutonium in them!" "Yeah," the CEO says, "but they're free!"

SM: Jonathan, what has been your key to understanding and cracking this market? There have been a lot of failed attempts at it. JB:

> ***The secret today for an entrepreneur is to do work for actual people, and use the Internet to help you. Providing tools or Web apps and hoping to get licenses, advertising, or page views isn't a very current business model.***

People have complicated work to do. The Internet won't solve it alone, but if you use the Internet, you'll improve the work.

SM: What you are promoting is a technology-enabled service business model instead of technology as a service. JB: Correct. SaaS is dead, long live SES, or software-enabled service.

SM: How will all of the political drama around healthcare affect the visibility of healthcare IT? JB: We've been hard at work bringing about the death of the old-fashioned software companies that dominate healthcare IT. Their business models and companies should be dead – they've been doing a great job of falling apart. Now, thanks to the federal government, they'll be given another five years to live, which will slow us down and prevent the evolution of software-enabled service business models. Eventually, they're going to die because at a fundamental level they do the wrong thing.

This is a long-term lesson about how important it is for marketplaces to disrupt themselves.

It is more important to get into new business models than squeeze the last ounces out of old ones.

But overall it won't hurt us. In fact, it has brought a lot of attention, energy, debate, and focus. That may allow the best model to win yet.

SM: You have a large TAM and the right solution – it is basically just a matter of building in a pure capitalistic way. I like that a lot. JB: That is certainly what we hope ends up being the ultimate story.

SM: I look forward to following your successes. Good luck.

The Smart-Grid Dilemma

I am no expert on smart grids, but like any conscious person, I have asked what steps might shepherd us toward smarter energy usage. Among the many options – among biofuels, solar, wind, and nuclear energy – smart grids come back as a perennial answer.

Let's explore what a world with smart grids would enable.

Today, consumers pay an average price for their energy consumption, irrespective of usage patterns (peak, non-peak), even as the wholesale price swings wildly. Because of this, consumers have no access to data reflecting their consumption patterns – no data telling them how and when they use energy. And why would they? Utilities lack billing systems that can bill based on peak versus non-peak consumption. Everyone, it seems, is left in the dark.

The obvious solution that comes to mind is a smart meter, right? Wrong. What do utilities make money on? Energy consumption. So what incentive do they have to install smart meters, making for a transparent process with variable pricing, if that would eventually reduce your energy bill, and with it their revenue?

Today there are many companies inquiring about the smart-meter market, but they all bump up against this critical resistance factor. President Obama's energy policy, therefore, needs to create an incentive structure for utilities to roll out smart meters so that regulated utilities make as much money promoting demand-response for energy conservation as they do building power plants and selling electricity.

Yet today, based on an archaic set of policies, utilities actually make money not by investing in new innovation, but in old-world infrastructure – to the tune of 12.5% on CAPEX. This incentive was set up when utilities were mandated to build infrastructure to extend energy beyond the urban wealthy. However, at the end of the first decade of the twenty-first century, this outdated policy remains in force, so utilities continue to build more power plants and sell more energy, rather than installing smart grids to cut power consumption.

Now throw renewable energy into this dysfunctional maze. Let's say President Obama's energy policy incentivizes consumers and businesses to install solar panels or build wind or biofuel farms, selling energy back to the utilities. These transactions can only be possible if all parties can execute proper accounting. Without smart grids and intelligent information systems inside the utilities, none of this is viable.

A small San Mateo, California–based company called eMeter has built an enterprise-class utility information management solution based on the assumption that utilities will want to have better control over their data and be able to control their pricing and billing with more intelligence. A dozen of the 300 largest utilities worldwide have backed this assumption, purchasing eMeter's solution. However, "most utilities are sitting back and watching right now," says eMeter chief executive Cree Edwards. "There's no incentive to being first, and there's not a large disincentive to being last."

The real driver behind Obama's energy policy, unfortunately, is global warming, not the market. Just as energy consumption needs to be contained, renewable energy usage also needs to become a larger portion of the portfolio. But none of this is driven by market forces because renewable energy remains more expensive, and less energy consumption would mean lower revenues for the biggest players in the market.

So how does innovation gain a foothold in this environment? The only solution is

government policy. Let's say grid parity will be achieved by 2012, or sooner. Through innovation, the cost of renewable energy will presumably become equivalent to fossil fuel–based energy. Government policy will still need to mandate that utilities draw a significant portion of their energy from a renewable portfolio. In fact, incentives can make renewable cheaper than fossil energy, which then offers the incentive for utilities to install information systems to manage the smart distribution of energy, better peak management, and so on.

However, today we are without a market force driving the adoption of smart-grid innovations, and it remains unclear whether policymakers have looked at the issue with an adequately savvy lens. Thus, smart-grid innovation will fall in the realm of corporate social responsibility unless government throws the required money into the utilities' pockets to install smart meters across the board.

Google, IBM, and other tech titans are lobbying hard to make this happen. IBM provides smart-meter technology to CenterPoint Energy, a Houston utility that plans to deploy 2.4 million meters over the next five years. They are also pushing for stimulus money to be routed into the utilities so they can invest in smart meters and master data-management systems. In doing so, they are playing the jobs card: installing new meters would create hundreds of thousands of new jobs per year. I see nothing wrong in this, frankly. In fact, instead of stimulus money going to General Motors, we'd all be better off if it went into the smart-grid drive.

Thankfully, the technology innovation is progressing nicely, and companies such as eMeter have patiently incubated solutions in anticipation of times when smart policy will usher in a smarter energy era.

Cree Edwards, eMeter

In 1984, Cree Edwards co-founded CellNet Data Systems, which provided advanced electricity metering data and communications to utilities via wireless networks. CellNet was dramatically before its time, but it provided Cree with fertile learning grounds in the complex economics and politics of smart meters. Today, the road has led him to eMeter, perhaps this time with better alignment of the stars.

SM: Take me back to where your story begins. What was the genesis of your entrepreneurial journey? CE: I was born a mile from here at the old Stanford Hospital, which I believe is still operational. My parents moved here from Long Beach. My father was an oil engineer, and in 1962 he became a venture capitalist. He was one of the original venture capitalists in the Bay Area. His name is Bill Edwards. He ran Brian and Edwards, which did mostly family and friends investing.

I did prep school in Massachusetts at Deerfield Academy, and then I came back to UC Davis. I graduated in 1980 with an economics degree and went to work for Control Data in San Francisco. I did a fairly complex training session in sales and marketing, as well as account management. I worked there for about a year and a half and then moved over to a GE information services company called Geisco.

I was managing major accounts for them in San Francisco, and one of the accounts I was involved in was Pacific Gas and Electric. During that time I went to a conference in Arizona and was introduced to the utility industry as a whole. In that seminar, people talked about inefficiencies in electric utility companies. One was the inability of the utilities to send price signals to customers. Utilities ended up with enormously complex peaking issues. Everything the utilities had to do was around building plants and equipment to cover peaks.

The problem was that this was addressed by building plants and infrastructure to support peaks. But the solution, which is extremely simple, is to send a pricing signal. If the commodity is scare, you charge more; if it's abundant, you charge less. But utilities couldn't do that because the meter was at the point of sale, and they didn't have the information from the meter to do variable pricing over time.

This was my start in the entrepreneurial world. It seemed simple to me that you would put a computer in the meter and the computer would record at what time energy was used. You could then give that to the utility in order for them to motivate their customers. It was a huge marketplace: there were a lot of meters, it was definitely needed, and you could gain access to the marketplace through a small number of customers.

So I contacted a friend, Larsh Johnson, who was a Stanford mechanical engineer studying the design of microprocessors. I brought him a meter and asked if we could put a computer inside it to gather the information. Three days later he had a working prototype with the old Radio Shack computers.

SM: What year was this? CE: It was about 1983. Between the time we started this and the point at which we actually built something that was of interest as a company, I had moved on to a startup called Octel Communications. They made voice mail systems, and I was one of the very early sales guys there.

SM: How long did you stay with Octel? CE: After nine months I took the idea I had about a computer inside the meter to Pacific Gas and Electric. I showed them the concept and asked if they would buy it if I built it, and of course they said yes. From there we decided to raise some money, which took us about six months. The initial investor was a subsidiary of Arizona Public Service in Phoenix. They put in several million dollars, and we began engineering computers that would go inside meters.

SM: What would that do to the pricing structure? Meters are pretty inexpensive devices, and at that time computers were fairly expensive. CE: We could build it and sell it profitably for less than $100 installed. GE and Westinghouse built enormous things that cost $500. We took state-of-the-art technology and reduced the smarts in the meter down to a single ASIC chip.

SM: You knew enough about electronics to make this happen? CE: I knew enough about electronics to get Larsh to do the work! The concept was mine, but the implementation was his. We made those things under a company called DAC, which stood for Domestic Automation Company. Our focus was to get the information and get it to customers. We sold hundreds of thousands of those across the country as stand-alone devices.

After two or three years, we realized that the challenge was not only getting the data from the meter, it was getting it into the utility system and then back out to the customer. In the late 1980s, Larsh and I spun out a different group and created a communication system. Those meters communicated optically through the glass. A person would walk up to the meter, put a probe in front of the glass, and data would be exchanged between this handheld device and the meter.

SM: So it was still a manual process that required someone walking around? CE: Yes, but that was all there was back then, so it worked. We developed a proprietary communication network. Then DAC morphed into a company called CellNet Data Systems, and we built a really interesting two-layer communication system in a cellular structure. There was a local area network that used a spread-spectrum radio to get the last hundred yards between a meter and a pole top. Pole-top devices would capture the data and communicate it back over a wide area network. There was no cellular network for a wide area network then, so we literally created both networks, including all the protocols and communication handoffs.

SM: Once you had developed the cellular network, did you try to operate it yourself, or sell it to utility companies? CE: We tried to sell it to utilities, but the difficulty in the utility marketplace is that the way utilities are compensated is a percentage of assets in the ground. If a power plant is built, they make 12.5% after tax. If they buy an office chair, they make 12.5% after tax. There is no incentive for electric utilities, outside of regulatory oversight, to be efficient.

SM: I am assuming this comes from when the industry was originally regulated? CE: Yes. When electric utilities were first established, somebody would build a power plant and run a wire across town to a commercial or industrial site. The result was a mesh of wires. In old pictures of New York or Chicago, you can see this very clearly.

But it was quickly recognized that it wasn't an effective model. The result was the creation of regional monopolies such as the City of Palo Alto and Pacific Gas and Electric. The first goal was to obtain highly reliable power, which meant utilities had to cover the peak. The second goal was

to get energy to everybody, not just the wealthy.

Back in those days, a utility wouldn't just run poles out to farmer John's farm. It would never be cost effective. Utilities were told if they built the infrastructure, they would then be allowed to rate base it, and they could earn money from that. In essence, their risk was covered for them.

SM: That created the incentive for infrastructure to be rolled out. Is that where the 12.5% is coming from? CE: Yes, but it varies based on the relations between the local utilities and the commissions.

SM: Which means there is no tie between how efficiently you run your company and related compensation. CE: Correct.

We were trying to sell technology that allowed utilities to operate more efficiently, but for the CEOs of these utilities, the investment in our product was not in the best interest of shareholders because of the way that market was structured.

SM: Fundamentally, however, that is exactly what needs to happen. What happened in terms of selling your product in the late 1980s? CE: There was no incentive for utilities to take the risk and purchase the product. So we morphed the CellNet business model into a services model wherein we would install, own, and operate the entire network.

SM: That must have been an expensive venture to build. CE: It was. We had to go out and find the funding based on 15-year contracts we signed with utilities. The level of service we had to provide was captured in a foot-thick service agreement document. We would then take that contract out and fund it. We built everything: the hardware, software, integration, and communication. Ultimately, we rolled out 10 million points throughout the US.

SM: When you finally cracked that formula, what switch flicked in the minds of utility CEOs? CE: It was risk mitigation. They weren't taking shareholder risk – if we couldn't make it work, they didn't have to pay.

The business model at the time was to branch out into other telemetry businesses. We would monitor vending machines, parking meters, and become an overall meter monitoring business. Our model was based on building the infrastructure and then selling other services under the umbrella because we owned and operated the network.

We took the company public in the late 1990s. The model we used for financing was very similar to what the cellular companies were doing to finance infrastructure. That was back when high-yield debt was a popular instrument. Banks were financing the contracts based on revenue growth over time.

SM: What did you do after you left CellNet? CE: I started another company to build applications under the networks. When CellNet went bankrupt, that relationship split. We always knew that at some point utilities would need more data, efficiency with the data, and improvements based on the data. The challenge was when and what would be the driver. In 2001 and 2002, the energy crisis in California forced regulators to focus on the issue and ask how they could fix the problem. They finally recognized that energy efficiency was important to them – that was a game changer.

We had developed an enormous amount of domain expertise, having rolled out 10 million devices, so I assembled the key members of the CellNet team to do it one more time. With that group back together, we started eMeter on the premise that the world was different today – people were building communication infrastructures.

SM: Were you assuming the data was available? CE: You have to assume that it can be made available at a reasonable price. We focused on capturing the data when it came out of the fire hose and manipulating it for the utilities so it could be utilized by their legacy systems. A utility can install a very complex data infrastructure, bringing back terabytes of data from millions of distributed endpoints. But they have legacy billing systems that have difficulty cutting a bill once a month, so there's certainly no place to put the data.

We built an extremely robust enterprise middleware package. It ended up being called Meter Data Management, for lack of a better name. That's a tiny subset of what we actually do. There are probably 15 companies out there worldwide who built the infrastructures. We're communication system agnostic, so we'll support whichever of those 15 companies a utility company elects to put in the field. Our position is that 10 years from now, the meters and communication systems will be different than they are today. You need to protect the enterprise and application layer from changes down below, so we built the system to support multiple communication systems in a service territory.

We then embedded business processes to make all of this work. The difficulty isn't in the individual meter transaction, it's in the volume. When you get millions of points, you need to have embedded business processes. That has allowed us to integrate into the work management systems, outage monitoring systems, billing systems, and customer service systems.

SM: You are essentially providing a master data management system to make the data accessible by upstream applications. Is that a fair summary? CE: Yes. The goal for us is to get the data to both the utility and the user.

SM: You provide the utility with consumer interfaces? CE: They should be able to, but the infrastructure isn't always in place to support that. We've built systems wherein consumers can go online and see what their load is like and how their consumption compares with their neighbors. The idea is to make energy use more transparent to the end user.

If you make the data available to smart people inside the utility, and if you make the right data available to the consumer, then the right decisions will be made regarding the use of energy.

SM: If I understand correctly, you are saying that energy pricing could be much more dynamic than it is today, and that if pricing more accurately reflected demand, it could adequately address supply concerns? CE: Right now consumers pay the average, so it doesn't matter if you consume at midnight or at noon, even though the wholesale market can be 10 times as high at noon. Having a solar panel is cost-justifiable if you're competing with peaking load from a utility. Our view is that if you create transparency, an enormous amount of innovation can take place.

SM: What incentive do the utilities have to buy your solution? CE: The public utilities

commissions, who are ultimately the utilities customers because they affect utility profitability, have recognized there's a problem, and it can only be solved with better information systems. These commissions have gone to the utilities and asked them to put in our products. They then allow the utilities to account for the cost in the rate base and earn on that.

SM: You essentially become capital expenditure on which they can earn 12.5%? CE: Correct. That seems to be the best approach under the current regulatory structure.

SM: A regulatory structure that is convoluted and brain-dead. From my perspective, we need to see some new things happen. The return on assets at 12.5% is too high; it should drop to somewhere in the 6% range. I also think utilities should be able to share in efficiency earnings. Regulators need to create incentives for conservation and peak reduction. A regulatory committee could create a baseline and let the shareholder earn 30% of what could be generated out of efficiency savings, passing 70% on to rate payers. But right now there is no incentive for utilities to save energy. CE: That would be a significant change to accomplish. What we try to do is create an environment in which all parties involved in the energy lifecycle can benefit from our innovation.

SM: I understand that, but I don't see any real incentive for utility companies to change. As long as they can use the accounting classification "unaccounted for energy," they have absolutely no reason to innovate. Why should they care – they are getting paid 12.5% for energy they can't account for. Nobody can tell me that it is acceptable for a company to be unable to account for 10% of its product. I know of companies that can account for everything in their operations, right down to the rolls of toilet paper they buy. CE: Utilities have a unique marketplace because they must overproduce their product. You can't allow peak energy to intersect with supply or you get a brownout, which is very bad for everybody. So they must keep generation capacity at 15%–20% above peak demand to avoid brownouts.

SM: As a result, there are power plants that sit there year-round with a full staff just in case they are needed, and utilities are earning 12.5% on that asset. There is no incentive to be efficient. In fact, it appears that there is a disincentive to be efficient. What I want to understand is how you are going to build a successful company in an environment in which there is no incentive to be efficient. CE: Every utility in the developed world recognizes the need for the development of an information infrastructure as a direct feeder to the smart grid. It's a direct feeder to the energy industry of the future, all based on information they do not have today. Regulators are telling them to build the infrastructure to get the data.

We track the most advanced states and countries throughout the world. We approach them and tell them that if they're going to build the infrastructure, they're going to need the software to run it.

SM: How many states and utilities have you been able to crack so far? CE: We have a dozen utilities so far, as well as one starting up in Australia and another in Finland, which are building the infrastructures. There are early adopters in the utility industry, but to date nobody has installed an end-to-end system, getting all the price points and functionality. Most utilities are sitting back and watching right now. There's no incentive to being first, and there isn't a large disincentive to being last. What we're seeing now is the beginning of the movement of the herd, getting these things up and running.

SM: How do you conduct sales? CE: We sell directly and through system integrators. IBM has sold us into several of their accounts. Accenture has sold us in Europe.

SM: Who is the competition in your space? Are there any other players? CE: The guys who make the metering hardware make a subset of our software to support their hardware and get it plugged into billing systems. We compete with them on accounts. If a utility is building out for all of their customers, we win 90% of those cases.

Other potential competition comes from the companies selling the next generation of legacy systems. That would be SAP, Oracle with their SPL products, and so forth. At both the metering end and the system integration end, there are gray areas where everyone is still trying to determine what goes where. We, quite frankly, don't care where it goes as long as it's accounted for.

When you get millions of devices operating daily, the challenge becomes managing exceptions. If you end up with a large exception log, you'll never catch up. All of that has to be automated. We work with SAP, and they recommend us into their accounts. Nobody has recognized the problem in the same way we have. We started with a clean sheet of paper for this particular problem, and we solved it.

SM: From where you sit today, and considering the decades you have spent in the energy business, when you look at the energy market, where are we going? CE: The price of oil will change over time. The supply and demand relationship will change over time. The most important thing for the industry is to tie together the basics, where supply and demand are represented through the marketplace by price. Market forces should be allowed to dictate what makes sense in terms of technology and innovation.

We need to create natural marketplaces where smart people can do things to create and innovate.

SM: Things such as variable pricing and carbon content need to drive the market. CE: And it needs to be a functional marketplace. The information that would allow it to function does not exist today, for good reasons.

SM: Because the information infrastructure needed to support information-driven regulation does not exist today. CE: If someone came out with an incredible electric vehicle, today's grid could not support it. You have to be able to track it, manage it, implement it, and bill it. Israel has recognized this. They're building infrastructure to support electric cars. We don't have that here. If you have the information, then you can build it. Nothing being developed in cleantech separates the end user from the utility. It's going to coexist – you're not leaving the grid. In order to allow it to coexist, you have to monitor, bill, and in some cases control it remotely in order to ensure the grid doesn't collapse.

One of the big drivers in Finland is their enormous amount of wind power. That's a big challenge because you have a lot of distributed facilities putting energy onto the grid.

SM: Is that energy characterized as wind power? If I am a regulator and I need to figure out how to develop and implement new energy policy, then I would like to know what energy was created with solar power versus biofuel, at which time I could provide utilities tax

incentives. CE: The state of the regulator right now is that they know they want wind power, and they're depending on the utility to deal with it. But regulators don't understand that it's incredibly difficult for utilities to deal with.

When commissioners do come up with interesting initiatives, utilities aren't able to support them in volume. They can do small trials, but nothing to scale. They must be able to characterize the load, track it, and reconcile it with everything else. The exception to that is if everything is completely off the grid.

SM: For the alternative energy dream to come true, utilities will need to be a part of it. CE: Sometimes we focus too much on consumers and not on the end user. Wal-Mart wants to do something special with energy in all of their stores. In an ideal world, Wal-Mart will hit a Web site and see their entire energy portfolio, and the portfolio should be accurate within minutes.

SM: So they are a consumer of your product lineup? CE: Yes, but they're doing it with one-off things right now. They can't do it through the utilities yet because not all of the data is there. Eventually, however, information will be available.

SM: If Wal-Mart puts in solar panels everywhere and mitigates a portion of their energy with solar, and if there is a policy that says that companies that do so will receive a credit, then they need to account for how much they are generating. CE: Yes, but there's another benefit as well. I believe that if you can account for it, you won't need subsidies. It will simply make business sense, and it will pay for itself. This would change consumer habits as well.

One of the biggest loads during the day is the refrigerator. If they made a refrigerator that did thermal storage instead of running compressor cycles, you could cut its energy use by 90%. It would take no time for GE to do that if there were actually a market for it. But there is no market because there's no incentive for the consumer to avoid using peak power – the price is all the same.

SM: Let's talk about the teams surrounding Obama. What is your sense of their awareness of these issues? CE: I know Obama has a lot of bright people looking at the problem. But there is too much attention on the artificial stimulation of innovation and not enough attention on fixing the base infrastructure to support a marketplace for that innovation.

What Obama should do is come out and say, "I want every customer to have access to their energy usage in five years so they can make purchase decisions based on real energy information."

SM: Thank you, Cree, for your time and insights. It is such a pivotal sector.

Shoestring Innovators

Open Source Means Business

Everything around us had been choked up: credit, equity investments, mergers and acquisitions, initial public offerings. The slowdown is strangling innovation and suffocating entrepreneurship. But some entrepreneurs have found ways to build their companies on a shoestring, using open-source software to make money off something generally considered free.

Take Brian Behlendorf, an open-source pioneer recounting earlier days: "The term 'free software' made it sound like an anti-capitalist movement, yet the reality is we were hardcore capitalists," he says. "We liked a lot of the attributes of that type of software and felt a re-branding effort was needed. That's when the term 'open source' was coined."

And it was Behlendorf's capitalist instincts that led him to later found Brisbane, California–based CollabNet, which makes collaboration software that allows remote engineering teams to work together. CollabNet's software was built from a free open-source application called Subversion, which was used as a sort of Trojan horse to get into accounts. Early customers like Hewlett-Packard and Sun Microsystems legitimized CollabNet's product and business model, which straddles the line between open source and software as a service.

Eventually, Benchmark Capital funded CollabNet, but not before CollabNet was quite far along. Today, the company has over 500 customers, including enterprises with over a 1,000 users each. By all accounts, Behlendorf's venture has a firm footing in capitalism.

Another entrepreneur, John Roberts, armed with a blind faith in the open-source movement, founded the now famous SugarCRM. Having grown up dyslexic, Roberts's later journey is all the more inspiring. Roberts, formerly in product management at E.piphany, recounted how he founded Cupertino, California–based SugarCRM.

"Around the same time MySQL started getting some traction, I convinced two strong engineers at E.piphany to join me," Roberts says. "We all resigned together and started SugarCRM on April 10, 2004, without any angel or VC money. It was the three of us, each in his own house with headphones on, writing and designing code and posting it up on SourceForge.net. We did that for three months."

And soon enough, people all over the world started downloading the code. So Roberts decided to raise venture money – lots of it. Fast-forward to 2008: SugarCRM has more than 4,000 customers spanning 30 countries.

On another continent, Australian entrepreneur Rod Johnson took his expertise in enterprise Java and wrote a book. "With that book, I published 30,000 lines of code illustrating the concepts in the book," Johnson says. "A lot of people were interested in the code, and I was approached to open-source it, which I did."

Those lines of code became the framework for Johnson's company, SpringSource. So how many people use the software? "Our best estimate is that two-thirds of enterprise Java users are utilizing SpringSource," he says. "I would say that the user population is around one million."

And how does SpringSource make money? "Monetization was originally around consulting and training," Johnson says. "We still have a fairly large training business, but the primary monetization model is around software. We have a number of software add-ons that improve the ownership experience of SpringSource." Add to that 24/7 support via subscription and an offering far less complex than products from Oracle and IBM, and it's plain to see that this ambitious open-source application server intends to challenge these two giants.

As of 2009, however, SpringSource won't go it alone. Having doubled revenues every year while securing substantial venture funding from Benchmark and Accel Partners, SpringSource was acquired by VMWare for $420 million.

What I like about these entrepreneurs is that they utilized their own coding skills and the low-cost open-source development and distribution model to solve a specific problem and gain early traction. Uttering the terms "open source" and "making money" in the same breath may seem like an oxymoron, but these entrepreneurs have managed to merge the two seamlessly.

If you are an engineer pondering your career path, look to commercial open source as a prime model for shoestring innovation. After all, while the world scrambles to recover from economic crisis, you can either jump-start your entrepreneurial career or waste six to nine months looking for a job. I would rather spend that time taking my destiny into my own hands.

Brian Behlendorf, CollabNet

When I think open source, I think about a certain well-known figure from my grad student days at MIT who slept in his office, never showered, and believed that software should be free. Today, I bring you a different sort of open source pioneer: one with business sense, and one who has opened a wide array of possibilities for shoestring innovation within the commercial open-source domain. Brian Behlendorf's venture is decidedly capitalistic.

SM: Brian, let's start with your personal background. Where do you come from? BB: I was born in 1973, raised in southern California, and went to one of the top six public schools in California. We were right down the street from Jet Propulsion Labs. All the scientists sent their kids to this school.

SM: Did your father or mother work there? BB: No, my parents met at IBM. My father was a Cobol programmer, and my mother sold system 360s and mainframes and such. That life looked about as exciting as accounting to me. I'd go visit my dad at work sometimes, and it would be nothing but green and white paper. We had punch cards we kept shopping lists on. I had a TRS80 at home and was learning BASIC from first grade on. From junior high onward, I didn't touch the computer unless it was to write a term paper. I wasn't a big gamer, but I was into science and math.

At the end of high school I didn't know exactly what I wanted to do, and I felt that going to a school with a lot of different options, like Berkeley, would be the right thing. I went to UC Berkeley and originally enrolled in physics. Of all the sciences, I felt physics had the least amount of brute memorization. But after three semesters there on the honors track, I'd lost the plot. The sense of intuitiveness had disappeared for me. However, from the first day I arrived on campus and received an e-mail account, I found myself absorbed with the Web. This was in 1991, so it was e-mail and FTP and that crazy thing called Gopher. I really found myself enjoying the social aspects, like the music-related mailing lists, so I started some electronic mailing lists.

SM: Do you have a background in music? BB: Nothing more than being an aficionado. I was the school DJ for three years in high school. Early on at Berkeley I set up a server on a spare system on which I learned Unix. Like most people in this space, you teach yourself through man pages, and I used that to set up a Gopher server with music lists and flyers and things of that nature. That progressed into the Web, and that progressed to a friend whom I met through a shared interest in music who said they were starting this new magazine called *Wired*. We were all about digital culture, and we thought that putting our articles online would be a cool experiment, so I started there in 1993 for $10.00 an hour.

From 1993 to the beginning of 1995, I worked at *Wired* and set up the first Wired.com Web site, which was one of the first nonacademic Web sites up. We also launched Hotwired in 1994, which was the first ad-driven Web site. I remember sitting and thinking, "How wide should the default banner be?" I did the banner rotations and got involved in patent lawsuits over completely trivial techniques that people actually went out and got patents on, like banner rotations.

Parallel to that, I was launching a company called Organic, which went on to build Web sites for Harley Davidson, Levi's, and other top brands. Initially it was for record labels and book

publishers. I shifted over to Organic in 1995 as the CTO.

SM: How did you get involved with Apache? Was it through Organic? BB: Organic was my day job, and I stayed there until 1998. Apache was a side effort that ran in parallel to Organic. Web technologies were brand new at the time, and companies were just starting to emerge with commercial Web software. Most of the software used to build the Internet was freely available. We were using the NCSA Web server, which was from the same group that put out Mosaic. We were hacking on that server when their team lost a lot of developers to Netscape.

The users of that community had a moment of self-realization, and it was decided that since the main developers were going to be lost, the software should be maintained on its own. We determined it was easier and more cost-effective for us to fix a few bugs and add an occasional feature by working a couple hours a week than it was to spend $5,000 per CPU on commercial Web server software that didn't seem any better. That, in short, was the genesis of the Apache project.

SM: Was the word "open source" coined yet? BB: Not yet. The term came about in 1998. I attended the meeting where it was coined. At the time, free software had started to take a political bend, which didn't describe or illustrate the practical advantages a lot of us saw.

The term "free software" made it sound like an anti-capitalist movement, yet the reality is we were hardcore capitalists.

We liked a lot of the attributes of that type of software and felt a re-branding effort was needed. That's when the term "open source" was coined.

Apache grew from one mailing list, one CVS tree, and one simple bug database to a couple dozen projects. We established a template to guide groups as they worked together. My own role shifted from being a programmer to being somebody who thought about how the community formed, how it accomplished tasks, how it made decisions, and what tools were needed to support the effort. The main concern was how to develop a consensus-oriented process that wasn't design by committee.

The tools at the time, for example CVS, were equivalent to the classic VW Beetle. They were insufficient for doing real work. They did, however, work at a certain level, and when they broke, people knew how to fix them. But something new was definitely needed. Likewise, the integration between the older tools such as the mailing lists, bug databases, CVS, and other development software was nonexistent. For the Apache project, I had to piece these elements together with duct tape, baling wire, and a whole lot of manual labor. That's when I started thinking there had to be a better way to do this.

SM: Was Apache a nonprofit from 1995 to 1998? BB: Yes. It's a nonprofit, membership-based organization. It has a couple hundred members and a couple thousand contributors. Obviously, there are millions more who've used the software.

Apache certainly grew and grew fast. In 1998, in part because of the interest and involvement from major players like IBM, Sun, and Oracle, we realized we needed to form an actual entity. Otherwise, someone could've found a patent issue and come and taken our homes away! We created the Apache Software Foundation – I served as president for three years and was on the board for another four years after that. Today, I've largely handed things off.

SM: Are they corporate members? BB: The members are individuals. It's very much like a guild. People are invited to be members based on an established history of contributions to different projects. I believe there are about 50 different projects within the organization right now.

SM: Is there any financial support? BB: There is today. Just last year they established a corporate sponsorship program. Some money was spent here and there for some systems, but there's a very independent-minded streak in the organization. There's been no full-time staff. Hardware and bandwidth end up being donated by different groups. For example, at Oregon State University there's a big data center for open-source projects – Apache is one of the big residents there. But there's no full-time staff compared to what a lot of nonprofits have.

SM: And this all happened while you were still full time at Organic? BB: Yes, the lines between the two are really blurry. Organic benefited tremendously from the attention Apache got. They were able to make a case to new customers that they could really build interesting projects because they had people who contributed to the Apache community and were experts at all the various Web technologies.

SM: Was Apache the only open-source project during that timeframe? BB: It emerged at the same time as Linux. In 1998, Netscape released the code to Mozilla. I actually joined their foundation as a board member in 2002 and am still on the board there. What was clear was that Apache was the poster child for a lot of the efforts going on. It was perhaps the most public, high-profile open-source project because we had numbers. The site NetCraft did a monthly survey of every Web site that was up – part of that survey was to ask the servers what they were running. Because of NetCraft, we know Apache powered more than 65% of all servers from 1996 onward. You can still go and look at that chart today. You'll see Microsoft coming up and going down. You'll see Netscape going way down to zero. It provided the numbers that allowed Apache to become a business case, which in turn allowed a lot of credible businesses to use Apache for their servers.

SM: In your eyes, what makes open source work so well? BB: That's a question I first started to answer almost 10 years ago. Back in 1999, I brainstormed quite a bit with Tim O'Reilly about what really made open source work. At the time there were obviously companies like Red Hat emerging as support organizations, but I wanted to do something at one-level meta. I wanted to address the question in a more abstract form. My goal was to distill it down to a science, make it repeatable, and take the answer to the rest of the software industry. After coming up with a couple different open-source business models, I realized it was about the tools developers were using to foster a collaborative development. These are tools designed for wide area networks and transparency in the development cycle. They're designed for software initiatives in which a core team of developers is surrounded by concentric rings of people involved at different levels. There are the naïve users, who have questions or want to suggest new features, all the way to people who submit patches.

Ultimately, it was that question that was the genesis for CollabNet. We got our funding from Benchmark Capital in July of 1999, and I hired Bill Portelli, our CEO, in September.

SM: Can you tell us more about CollabNet? BB: Sure! We realized that what was needed were robust tools for collaborative development. We started with a baseline consisting of a couple

different tools, forming a sort of integration layer. I went out and signed up HP and Sun as our first two customers. That really set an interesting tone. In Sun's case, they were launching new open-source communities. Initially it was NetBeans, then it was OpenOffice, and then it was Java.net and all these others. We were an easy way for them to access these tools. We ran the infrastructure for them as a managed service.

SM: You were basically software as a service for an open-source community? BB: Exactly. In HP's case, there was a different kind of use that I never anticipated being as interesting as it has been, which is building open-source communities inside the company and between the company and its business partners/developers. That model actually accounts for most of our business today.

I had never worked for a big company, so I always assumed the software engineering management had all the development problems sorted out – that it was just us cheapskates in the open-source world who were making do with simple tools. In reality, corporations had no tools to enable engineering teams to work across geographic boundaries with insight into other teams' efforts. We found a couple people inside HP who were very visionary – our initial work grew very quickly from a couple dozen users in their Printing and Imaging division until it was the standard tool for Printing and Imaging, their enterprise group, and other groups as well.

SM: CollabNet is a commercial company that secures traditional business contracts, right? Companies pay CollabNet versus CollabNet being an open-source provider? How does that all work? BB: At one level we are software as a service. We charge for access on a per-user, per-month basis. Over the past few years, we've developed our processes to the point where we can also run this on a customer's site or network for them, and if needed we can also give a client the rights and permissions to run it independently. Regardless of the model, we still charge the same price based on that per-user, per-month model. We gain operational efficiency being a software-as-a-service provider. Our code stack is a combination of open-source code and proprietary code, which we license commercially.

SM: Yet not everything in your portfolio is proprietary? BB: There's an interesting story around the open-source stack. It's not just preexisting projects like Apache and Linux. There's a tool we developed ourselves, which we've leveraged a huge community around, called Subversion.

> ***Originally our goal for Subversion was for it to be a category killer in the version-control space. We didn't want something that was just a successor to CVS. It was important that it be a tool people migrated to away from available commercial tools – and they have.***

SM: What was the rationale for the Subversion project? BB: Developing Subversion as an open-source project had strategic and tactical implications. Strategically, we did it because we needed something disruptive. The space definitely needed the tool, yet we didn't have the resources to provide it alone. The Subversion tool is a tool that keeps track of the history of your intellectual property. It's a time machine for your source code.

Our theory around making it open source was that to build up the consumer confidence to the level it would've required to be a successful venture would have cost us tens of millions of

dollars in marketing. Putting it out there as open source and getting Apache to adopt it – which they have – shows that it can scale and keep a rich and high-fidelity history.

SM: How widely adopted is it? BB: We estimate there are three to five million Subversion users out there. I hear about companies migrating to it all the time.

SM: You explained the strategic reasoning. What was the tactical rationale? BB: Tactically, we did it because there was no way we could've built a team large enough to do it ourselves. Tactically, we've had three or four full-time developers on it who've been able to leverage the efforts of a larger community. Our role has been that of the air traffic controller: working on a core, laying out a roadmap indicating how it should all work, yet ensuring there are plenty of places for others to plug in. This includes other companies as well – who also sell support services based on Subversion.

We wanted this to become the default standard for the entire industry.

For us it has become the thin edge of the wedge inside the company. If a company is already using Subversion, we can come in and help them support its usage, but by the way, we also have all these other tools that plug in very cleanly.

SM: Let's talk some more about commercial accounts. In a way, Subversion is like your Trojan horse to get into a company! BB: That's funny! I prefer to refer to it as the thin edge of the wedge! At least that's not as bad as the term "viral." I hate it when I hear open source referred to as viral. The truth is – yes, it does become a great entry point for us.

SM: In commercial accounts, in particular the larger corporate accounts, what do you see as competition? BB: The biggest thing is the do-it-yourself mentality. In so many cases developers or system administrators pull together disparate tools and do the same thing we did at Apache. They piece all kinds of tools together with baling wire and tape.

Our approach is beneficial for those cases. We believe there's a lot of value in integrating discussion tools directly into the development programs. Having that tight link is really a knowledge-management capability. When people send notifications over to a SharePoint or portal, the value gets lost.

Often, we come in and our products become a standardizing tool. Groups use disparate tools for different purposes. Throughout enterprises these tools are selected on a team-by-team basis, which leads to different groups selecting different tools, making collaboration much harder. That's difficult for enterprises because in each case they have to get up to speed on how someone else's tools work, open holes in the firewall, and things like that. In our scenario, we're standardizing the tools and interaction methods of these teams and becoming the greatest common denominator of all the tools being used.

SM: People have to remember a lot of tools come from a different era architecturally. BB: Exactly. They come from an era when people were sitting in the same room, and when complexity was almost considered a virtue rather than a drawback. They were designed for an era where you had the core developers, and then everybody else was a naïve user. One thing that's nice about Subversion in particular, as well as the rest of our tools, is that you can be a business user and get visibility into the top 10 projects a developer is working on.

You can mount a Subversion repository as a folder under Windows and start using it to store your PowerPoint presentations, your spreadsheet listing the features the field is asking for, or even give people in the field direct access to your bug database. We're really going for a smooth continuum between "producers" of the software and "consumers" of the software. It's to the point where we have customers opening their collaboration environment to their key end users – both sides want to play a role in developing the environment.

SM: Do you have all of the project management capabilities as well? BB: We're definitely a lot more than just a bug database. We also show you the features customers are asking for. We can let your customers vote on potential features.

When your customer base starts ranking their priorities, you gain incredible visibility.

That feature becomes a key part of release planning and a type of project management tool.

SM: How about your resource management capabilities? BB: Resource management is interesting. In terms of personnel management and time management, there are some really great products out there, and we're not going into that market.

In terms of management of hardware and server hardware, we have CUBiT. Last year we introduced CUBiT, which is a virtualization environment for building test servers.

SM: You said you have been doing CollabNet for eight years now, and you have 450 customers? BB: In terms of new customers, from 2006 to 2007, we had over 200% growth. A lot of that has been due to Subversion bringing in midsized companies, projects that have 20 or 30 users, all of which have the potential to grow.

The enterprise sale cycle is very long, but what we've found is that we're starting to get in without people engaging us directly. Through our site they sign up for a training program or for baseline support, and then all of a sudden there are 100 people at the company using one of our products. The company then looks at what other tools CollabNet has, and after we give them some demonstrations, we typically have 1,000+ users at that company.

We really do have a transformative effect inside of companies. Companies realize there's strength in numbers with a system like ours. The amount of efficiency and reuse they can drive and the standardization benefit they receive is tremendous. Inside an account like American Express, we're now the standardized tool.

SM: So the CIO of AmEx has blessed you? BB: Philip Steitz. In some accounts, like American Express, who are traditionally extremely conservative in their approach to how they build infrastructure, there are visionaries who do almost top-down revisions. These companies need someone to completely change the way they operate, the way they build software with partners. They recognize the need to adopt some of the principles that open source has pioneered. That mentality is a perfect fit for CollabNet. That's why we've seen a market uptick for us, and it's why we're becoming more mainstream.

SM: What is the size of a large account, from a dollar point of view? BB: Last year we had more than five customers whose annual contract value exceeded $2 million. There were another 10 that were $1 million or more, and the vast majority are $100,000 or more. Only the

bottom 30% are under $100,000.

SM: Let's focus a bit on the open-source universe itself. How do you see the movement changing, and what in those changes is significant? Take WordPress – they just raised a ton of money. I run my Web site on WordPress, and I don't pay a dime. BB: What's interesting is they have a software-as-a-service model. When you're using WordPress free, you don't even have to download it. One trend is that even though software as a service has risen, there's still a reason to do things the open-source way.

The open-source aspect to WordPress has enabled them to have a larger community who run things themselves, but in return they have fixed bugs, have helped with scalability, and have added plug-ins that do lots of interesting things. What started as a simple blog tool is now a platform. That kind of growth is something that drives interest back to the central provider of the service. That's why at CollabNet, even though our main business is software as a service, we drove the Subversion open-source project. Lots of people are running Subversion on their own, but at a certain point they'll ask us to just run it for them.

SM: What else do you see in open source? BB: There's tremendous growth.

Today, for every funded software company, whether it's enterprise software or client-side software, you'll likely find open source somewhere in the strategy. If it's not, it would be as foolish as launching a company without an Internet strategy. Even a brick-and-mortar company must have one today.

Open source is, ironically, this disruptive model that has become a standard part of the software development world. The trend today has been funding companies that go much further up the stack to analytics and ERP software.

SM: What are some of the more interesting projects going on in the open-source space? BB: I've been spending a lot of time with nonprofits who are using open-source software in very creative ways. One example is the Grameen Foundation, which runs an open-source project developing software to run a microfinance bank. They put it out there and now have 3,000 microfinance institutions in the world as potential users. It meets a certain set of conditions around sovereignty, flexibility, and ease of use that commercial software not only can't do but would not do if they could.

There's another project out there called Sahana, which was developed by some Sri Lankan developers after the Asian tsunami in 2004. They designed it to be ERP software for disaster relief. There was no preexisting software at the time. Now there's Sahana and a few other open-source projects in the space.

There are interesting ways that open source is broadening beyond just software. Wikipedia is open source applied to knowledge. And now we're seeing domain-specific wikis like WikiTravel. The concept of communities getting together and collectively maintaining something, whether it's code or content, is having a massive impact.

SM: The OpenCourseWare project is a very big variation of that. BB: The academic textbook world is in for a major shock in the next few years. They are so used to a lucrative business with limited competition that once the educators realize they can get together and create

better content, with greater freedom, it will be interesting.

I just heard a presentation by Henry Jenkins, who is a professor of comparative media at MIT. He was talking about how students in the classroom today are realizing that by using online collaborative tools they are made smarter than the teachers standing in front of them. They can sit in class in real time and correct the teacher. I think we're seeing something much deeper than just a next wave in software; this is an inversion of a lot of power structures in society.

SM: This has been a great story. Congratulations on the success! BB: Thank you. It has been a fun journey so far.

Rod Johnson, SpringSource

Rod Johnson is a quintessential bootstrapping entrepreneur who wrote a book on Enterprise Java and 30,000 lines of code to get his venture, SpringSource, off the ground. But before it could take flight, consulting and training revenues sustained SpringSource as it gained traction in the open-source community. When the time came, raising venture capital was easy!

SM: I detect an accent. Where is that from? RJ: I come from Sydney, Australia. But my accent is confused because I also lived in London for seven years, and now the Bay Area for a bit over a year.

SM: Is there much of a local entrepreneurship ecosystem in Australia? RJ: To be honest, I'm the wrong person to ask – very little of my IT career has been in Australia. I think the Australian economy has been pretty strong in the past few years, but it does have a bad reputation for not being able to retain talent. I think it's harder to raise money. There is an excellent education system, and a lot of great engineers come from Australia, but all too often they end up going overseas if they want to start a business.

SM: Like most economies. I think venture capital and startup financing is generally less abundant outside the US. Perhaps there are exceptions now in Israel, India, and China, but when I started my entrepreneurial career in 1994, I started my first India operation and the industry there was so immature it was ridiculous. Of course, that has changed completely over the past 12 years. But Australia – you don't see it too often on the entrepreneurial radar. RJ: No, and it affects your ability to get people to buy into the vision. We've found it's much easier to get employees in the Valley to seriously focus on an opportunity than it is in Australia or Britain. Both of those locations still have a bit of skepticism. If you tell a Briton or an Australian that you're going to build a billion-dollar business, they laugh.

SM: What was your upbringing like? Did you grow up knowing you were going to leave at some point? RJ: No, I really had no clear view at all about what I wanted to do with my life until I was at least 25. My first degree was in computers and music. I then got a scholarship to do a PhD in musicology. I wrote a thesis on piano music in Paris from 1830 to 1848. That was something I did without having to think too hard about it. I was very interested in doing research, and I felt I was learning a lot of interesting things, stretching myself in interesting ways. I then taught at Sydney University for a couple years.

SM: Did you ever pursue music professionally? RJ: I was a pianist. I suppose you can say I'm a pianist who doesn't play anymore.

I really wanted to keep up my programming skills, so I wrote a couple moderately successful shareware programs, and then I decided I wanted to switch to IT.

SM: Were you still in Australia through all of this? RJ: No, all of my studies were in

Australia, but I moved to the UK to do IT work. I started off as a regular developer and rapidly moved into senior architect roles. I worked for a variety of companies in the London area, including the Pearson Group, who own the *Financial Times*. I worked for London Clearing House as well.

SM: Where does the story of SpringSource begin? RJ: In my late 20s, I discovered that I had entrepreneurial instincts, which I hadn't expected. Looking back I can see it comes from my father. He absolutely hated the idea of working for anyone else. He invented a number of things and ran little businesses around them. He wasn't tremendously successful; if he had actually become a doctor, he probably would have ended up making more money, but he didn't care about being rich. The most important thing for him was independence. I definitely have elements of that.

One thing I find very, very frustrating was being in situations where decisions are being made that are going to doom some particular project and being unable to change that. I used to think of the analogy of WWI. The average life expectancy of a British lieutenant on the front line was two and a half months. If he was particularly good, it might make a few days' difference. The decisions were being made much higher up with tactics that were fundamentally flawed. A lot of IT projects are like that. The people doing most of the work and the people running the teams do not have that much influence on success and failure.

Very early on I was involved in Enterprise Java. I ran quite a number of successful projects, which I really enjoyed. Then I had to go back to Australia for six months because my mother fell sick. But I really loved the job I'd been doing for the past two years, so I decided I didn't want to take a six-month contract in Australia – it would be an anticlimax.

So since I didn't feel I could really achieve anything significant in six months, I decided to write a book on Enterprise Java. I rather naïvely thought I could write this book in three to six months, when in actuality it ended up being 12 months full time. During that time I found I was able to think differently – I was outside the workforce. It's difficult to think deeply when you have a daily job. I actually had the luxury of throwing away weeks of work if I thought it wasn't the correct approach. That ultimately became my first book on J2EE in late 2002.

Along with that book I published 30,000 lines of code illustrating the concepts in the book. A lot of people were interested in the code, and I was approached to open-source it, which I did. Those lines of code became the Spring framework.

SM: At that point, what was special about the code? RJ: It was basically infrastructure code. In Java Enterprise, at that time, there were application servers, which were typically from very large vendors like IBM. There were sets of APIs and usage models around that, which were defined by Sun based on the various standards of Java.

SM: People were using blocks of your code to build their own applications? RJ: Exactly. The Spring framework demonstrated a way that was dramatically simpler.

> ***At that time, the conventional wisdom in Java was that it didn't matter if it was complicated because real developers don't mind complexity. That's unbelievably destructive.***

The whole purpose of Spring is to solve the right problems to ensure that your business logic,

which you as a business application developer write, is simple and that the framework takes care of concealing most of the complexity.

SM: When you put your framework out there in the open-source domain, you did it as an individual, correct? What went through your mind as you saw the adoption? RJ: I've always had a somewhat hard-nosed attitude about it. When I was writing the book, I was doing it to help build my personal brand as a consultant. It was the same mentality with Spring at first, but it rapidly became apparent that it was at another level. Downloads went from tens of thousands to hundreds of thousands to millions.

SM: What year was this, and where were you? RJ: I wrote the book largely in Australia in 2001, and then I returned to Britain in early 2002 and published it in November of 2002. But everything really took off in 2004.

SM: How were you making a living from 2003 to 2004? RJ: During the writing of the book I went through all of my savings. We ended up probably $100,000 down in our mortgage because after going through the savings, there was more living to be done. So I went back into the workforce doing consulting. One of the things I learned in these consulting jobs was that I was even more right than I'd originally thought.

For example, I had a project in London that wasted £70 million, ultimately producing nothing of value.

SM: What was the problem? RJ: Basically they'd taken the approach to Enterprise Java that I criticized in the book – and that Spring was designed to address. There was no concern about complexity. Every part of the system was insanely complex. Any trivial requirement would require tens of lines of code and changes in the database – to deliver an entire system under those circumstances was impossible.

I stayed on that project for seven months, having pitched battles with the consultancy that was in charge of the architecture. Eventually, I couldn't stand it anymore, so I resigned and left behind a variety of documents of different lengths detailing why the project would fail.

SM: When you left, were you ready to start Spring? RJ: I did one shorter contract where I actually used an early version of Spring, and I found it to be successful. Then I started the company with a number of the other core developers. We had five founders, and we bootstrapped the company with consultancy.

In Enterprise Java the developers tend to be a bit more business savvy. One of our co-founders had worked previously for a VC; another couple had worked in large consultancies where they got a fair amount of exposure to business issues. We all had some business experience.

Along with our consultancy work, we did a training business based on our software. Afterwards we moved towards what we are today, a software business.

SM: When did you move to the Valley? RJ: After I decided to raise a Series A. That was in April of 2007.

SM: What was it like to pluck yourself from the UK and land in Silicon Valley? Did

you know people and have contacts? How did you navigate the Valley as an outsider coming in? RJ: That's an interesting question. Since I've been here, I've observed that the Valley tends to reject outsiders that it cannot categorize. But I don't feel like such an outsider because I fit a pattern. Also, Spring was so well known that we were actually approached by investors. Our experience has been so positive and easy – I almost feel guilty having discussions with entrepreneurs about raising money. We raised our second round six months ago. I spent one day doing four pitches, and we had three term sheets as a result.

SM: By this time the product was getting downloaded in an open-source mode all over the world. How did you build a monetization model, and when did that start? RJ: Monetization was originally around consulting and training. We still have a fairly large training business, but the primary monetization model is around software. We have a number of software add-ons that improve the ownership experience of Spring. You can get 24/7 support via subscription, which is important in large organizations. They get software updates for up to three years, they get monitoring and management software, and they get additional tooling, which is closed source.

Fundamentally, our model is one that recognizes that the open-source software is great – it's better than any alternative – but we provide things around it which make Spring even better, and we charge for those additions.

SM: What kind of revenues are you doing? RJ: We've doubled our revenues for two years in a row – we're now in the $10–$50 million range.

SM: How many users do you have? RJ: One of the frustrating things about open source is that it's really hard to truly know the number of users. We just don't know. Our best estimate is that we believe two-thirds of Enterprise Java users are utilizing Spring. We've commissioned a number of independent surveys, and they come back with that. So I'd say the user population is around one million.

SM: What do you estimate the total available market to be? RJ: Potentially, it's very big. In the past year we've launched an application server product because we think the incumbent Oracle and IBM products are too complex. That application server will address many of the issues corporations will face as they move to cloud computing infrastructures, so it could be very large. Analysts think the cap is around $8 billion.

SM: If you are doing an open-source application server, I have no problem gauging the size of that market. RJ: Obviously there was already one significant player in that space, JBoss. But JBoss was largely a commodity play, similar to MySQL. What we've done is brought genuinely new ideas to market, and that's what we intend to continue doing. That has changed the way people do Enterprise Java; thus, we see ourselves as being true innovators in this space.

> ***Open source for us is less fundamental to the company than thought leadership. Open source, for us, is a means to an end. The end in our case is that we honestly think we have the best solution.***

SM: If you are saying $8 billion is the enterprise application server market, you are

probably going to drop it down a bit. RJ: We're going to drop it down some. The reality is that many customers didn't need the products they were sold. That must be accounted for in the $8 billion. One of the advantages we have is that we're not associated with that baggage. If you represent a large company that sold people things they didn't need, you cannot admit that. A new challenger can come along and be a lot more honest.

SM: You can also play with business models and financial models that large companies cannot. You can come up with something hugely more efficient, whereas your competitors cannot – it would cannibalize their core market. RJ: There's been little economic incentive for large companies to give customers in Enterprise Java what they actually want. Oracle and IBM are really pushing people towards complexity, which doesn't necessarily meet their requirements. We're focused around point solutions that immediately address the pressing needs of a client.

SM: Do you see what you are doing in the application server market as an industry trend going forward? RJ: I think the industry goes through swings. It goes through times where it looks for best of breed, then it goes to suites, and then it goes back through best of breed. I think the biggest threat to this space is over-consolidation. Oracle bought BEA, and JBoss is no longer an independent vendor – that in itself is possibly a driver for more competition.

I think open source as a distribution model is unique. If you're a small company selling proprietary software without any open-source backing, it can be very difficult to get in the door. People get worried about source code escrows, but open source alleviates that concern.

SM: We are seeing this in the CRM industry as well. I think that this model, at this point in the evolution, is a real trend. RJ:

> ***In order to get new software in the door today it's pretty much essential to lead with open source. I don't see a lot of pure enterprise license players coming anymore.***

However, I do disagree with open-source zealots. I don't believe in our space that open source is a fundamental good. Our software is primarily used by large companies.

SM: They are perfectly capable of paying, and they should pay. RJ: Exactly. I've never gone with the rich installment philosophy. If things are free, then it will enable large incumbents to deposition open source as the threat. There has to be a viable economic model.

SM: Somebody has to pay for it. Programmers have to pay their mortgages! RJ: That might seem obvious to you and me, but you'd be amazed at the number of people who don't find this
obvious. I've offended people in the open-source community because I've always said that.

SM: There are also all sorts of free Web services, such as the social network services. The expectation is that everything is going to be free. But in that case, the VCs have to pay for it. One way or another, bills have to be paid. RJ: One of the amusing things about people in the open-source community is that they think VCs are demons. Ironically, these people are among the biggest beneficiaries of VCs. I think it's going to be interesting to see how this all plays out because this environment is going to drive a lot of companies to the wall. Obviously, early-stage

funding is going to dry up. Any company developing a lot of open-source software, but not near profitability, is going to come under a lot of pressure from investors.

We're not overly concerned about the downturn because we think we can help drive cost reduction. That has to be the conversation you're having with leads. But it will be a short conversation if you're not explaining how you're going to help him or her reduce their IT budget. I also think it will be very interesting to see if it forces a "growing up" to occur.

SM: I do like that you initially started out as a bootstrapped company. Do you think that helped you focus in the beginning? RJ:

> ***One reason I'm happy we waited three years prior to being funded, aside from figuring things out without the potentially unwanted help of VCs, is that we had to keep an incredibly close eye on revenues and expenses, month by month.***

Today companies are worried about being in a tougher economic environment, but we're not. We learned to live without eating our way through large amounts of money then, and we can do it now.

SM: Bootstrapping forces you to develop good habits. Earlier you mentioned you would have preferred to raise money a year before you actually did. Why was that? RJ: I think about nine months would have been fine. As soon as we figured out that we wanted to bring a server product to market and have a complete Enterprise Java software stack, rather than developing products that were complementary to other vendors, we should have raised money. We should have realized it would take more engineering resources than we could fund.

SM: Today, when you do your up-sell, do you use a direct sales force to work with your customers? RJ: Yes, we have about 15 in our direct sales force. Our total number is 130.

SM: You are essentially in the full CIO sales cycle. RJ: It's a lot faster because open source got us in the door. The terrifying thing, from an expense point of view in the traditional enterprise sale, is the cost of presales. Presales consultants are very expensive. If you're a closed-source play, you can get into proof of concepts, which becomes unpaid consulting. For a decent-sized software company like BEA, the cost of sales is 45%.

It's much cheaper for us. Our reps often talk to people who know our software better than we do. We have a fairly typical open-source model which deals with very large numbers of leads going through the system. We have in excess of 500,000 unique visitors a month to our community Web sites. They go into a lead-scoring and lead-nurturing system, and the most promising ones end up in the queues of the territory managers. We don't cold call.

SM: How long is your sales cycle? RJ: It varies, depending on the scale of the deal. The larger deals are probably three to six months. A larger deal is anything from $200,000 to $1 million.

SM: It is pretty good if you can close those types of deals in three to six months. RJ: Our training business is practically taking orders now. And so much of it's online – we even take orders by credit card, so some of it happens without any investment of resources on our end.

SM: Where do you go from here? RJ: We spend the next couple years getting up the level of revenue, assuming we perform to our projections. That will allow us to go public. Hopefully the IPO market will be back.

SM: Why do you care about going public? RJ: I think open source is a business where critical mass matters. We've already made two reasonably small acquisitions, but I do believe that eventually having access to liquidity of public markets could help us spread wider beyond the Enterprise Java space.

SM: My advice would be to consider not going public – stay in the private market as long as you can. Really great companies are trading at totally ridiculous valuations right now. What do you do in that situation if you are in the public market? RJ: I agree. There are dangers to corporate governance in the public market.

Many public companies are not run by the executives; they are run by the analysts.

SM: Exactly. You have to make all kinds of compromises to stay on the quarterly clock, which is not meaningful. Sometimes you have to make decisions for the long-term good of the company which compromise the near term. If you are in the public market, you do not have that luxury. RJ: It is rare to see public companies that have done it their own way. Oracle is a good example of that. Many analysts hated their acquisition strategy, but Oracle stuck with it. They've done very well with it.

SM: What about acquisitions? Are you planning any? RJ: This is a very interesting time for that. We've been approached by two companies in our space that are hoping we'll buy them, but neither makes sense. One was a financial black hole, and the other was interesting technology but non-core for us. I feel very bullish about the future, but I'm not going to take on something I don't fully understand.

SM: Frugal execution always pays off. This has been great; congratulations.

John Roberts, SugarCRM

John Roberts pioneered open-source applications by questioning the traditional model of selling proprietary software with large, expensive sales forces. In doing so, he cracked open an entire category of open-source projects, making the Web the primary distribution and sales channel.

SM: Take me back to where your story begins. What in your background helped you arrive where you are today? JR: I was born in Washington DC in the late 1960s. My father was a cardiovascular scientist at the National Institutes of Health for 30 years. My story is a little odd in that I'm the youngest of four, and my older siblings were excellent in school: one has an MBA, another's a heart surgeon, and the third is an engineer. I, on the other hand, had a really bad case of dyslexia and was failing out of school. As a result, I was this crazy rebel growing up; I didn't understand why I couldn't excel at school.

In the early 1980s my parents bought me a PC, and it really helped me. I went on to Virginia Commonwealth University and graduated in 1990 during the recession.

I knew I wanted to be in software, so I went to Georgia to work for IBM for a couple years, but I had been reading about Silicon Valley for about five years and knew I wanted to get there. So I started working on an early-generation customer-relation management system, which was client-server based.

SM: What company or system was that? JR: It was called Sales Technologies. They offered me a couple thousand dollars to move to California, so in 1995 I moved out there. It was a small software company, but it went all the way through IPO and was acquired. I spent 12 years in the trenches as a sales engineer, a product manager, and in product strategy.

I ended up working for three companies in the Valley. The first was Aurum Software, in 1995. I then moved to BroadVision, where I was the director of the e-commerce product line. During the recession I was kind of bored with my career, so I went to a company called E.piphany – they had a CRM product, which was my DNA. A year later I looked at the market and started thinking the market and the Valley were both inefficient.

This notion of building proprietary software that was a complete secret, followed by massive high-end sales forces selling it door to door didn't make sense when in reality only a dime per dollar was used on the product.

I decided I had learned enough. I was really frustrated with the notion of building ultra-serious business applications in a very proprietary manner. I couldn't care less about sales and marketing; I'm interested in building the best software on the planet and the enterprise behind the process. So I started to focus on open source.

SM: What did you think were the bright flashing lights of open source? JR: It was all about hope and belief. That's why in the fall of 2003 I decided to go for it. I asked my wife for six months to chase this idea. I knew I could get a job somewhere else, but I wanted to know if we could do something radical.

I spent hundreds of hours on the Web, questioning the traditional process – hiring engineers, getting product managers, writing your MRD, and because you're the smartest people on earth, building it in secret and launching it with an expensive sales force. Does that manufacturing process really result in the highest quality, most innovative software on the planet?

SM: When you started questioning this, was it a question you posed to yourself, or were you poking people to gather momentum as well? JR: It was a big debate at the time, but mostly it was a conflict within myself. I think entrepreneurs need to have blind ambition. If you're not blind, you're not going to do it.

When it came to open source, at least in 2003, the question was whether open source applied to anything other than operating systems, programming languages, and databases. The mentality was that geeks were not going to be interested in things that solved business problems.

SM: So in 2003 and 2004, there were no open-source applications? JR: There were lots of little projects, but not a single startup had been funded by a top-tier VC. I made up my mind in 2003 and wrote a business plan that said that if we wrote great software and put it on the Web with an open-source license, then we would know two things. First, we would know if the software was any good; if you can't give it away, nobody is going to buy it. Second, we would know whether I was wasting my time.

So I convinced two strong engineers at E.piphany to join me. We all resigned together and started SugarCRM on April 10, 2004, without any angel or VC money. It was the three of us, each in his house with headphones on, writing and designing code and posting it up on SourceForge.net. We did that for three months.

SM: What was the architecture of your software? Did you originally start out to do a CRM application? JR: Absolutely. The idea was to build the beginnings of a new generation of CRM built on a language that nobody owns, which was PHP.

We wanted to get to a critical mass of features as fast as possible, so we worked full time, pulling 100-hour weeks. We were laser-focused.

SugarCRM took off – people started downloading it from all over the world. We started seeing 40–50 downloads per day.

SM: What were they downloading? JR: Our entire code base.

SM: You did everything in a single code base? JR: It was modular, but we wrote it all from scratch. In most open-source projects, people take other people's code. We wrote ours entirely on our own, which made it unique. Then we chose to give away everything we wrote. Meanwhile, we had mortgage payments and three pregnant wives.

SM: Not a pretty situation. Why did you do it? Did you have any idea how you were going to make money? JR: We just believed. We didn't know how we would make money, but we hoped to create a commercial version, which we did. We only wanted to do a company if people liked the direction of the software and our approach as much as we did.

SM: What was your VC pitch? JR: Sugar is a human interaction platform. It helps people manage their interactions with each other. Most people use it for managing sales, support, and marketing. I believe there are five million companies in the US, six million in Europe, and another 30 million in China. This market is just beginning. Today it's dominated by the wealthiest of companies, but it has gotten somewhat broader with Salesforce.com and others. But our software is valuable for all of humankind and can be used by nonprofits, among others.

The idea was to open-source license everything we put out there, and if we were able to build some common interest, the bottom line would take care of itself. That's what we focused on. We told the VCs that the market was changing and the Web was leading the way. Our stance is that the way people buy software is radically changing and will continue to do so over the next 10 years. Companies are asking more questions about the development process and restrictions regarding proprietary software. Writing software in a collaborative manner and being open in the way it's done can be successful. Wikipedia started the same way.

SM: Yet Wikipedia is not a venture-funded startup. If I were a VC investing in Sugar, how would I monetize my investment? JR: The customer relationship market over the past 20 years has generated 15–20 public companies. It will continue to do so.

SM: True, but my question is what is your business model? JR: We have one common source-code tree, and we tag the source code by addition. During the build process, it splits out three different editions: Sugar Open Source, otherwise known as the Community Edition, which is totally free; Sugar Professional, which is sold under a subscription similar to Red Hat Enterprise Linux, though we own the copyright; and our Enterprise Edition, which has about 25% more functionality – it comes with support and training, both on-site and on-demand.

SM: What percentage of the business today is on-demand? JR: Twenty-five percent.

SM: Who is your customer base? Do you mainly have small businesses? JR: This is a very interesting area to explore. In open source there's very little control over who your customers are. As a result, we have everything from big banks to the Men's Warehouse. I would say the bread and butter is small technical companies you've never heard of.

SM: I can definitely understand how small companies would look for an inexpensive solution. What would be the driver for enterprise customers? JR: It's control and superior ROI. SugarCRM is the most modern CRM application written in the past five years. It takes about five years to write 500,000 lines of code. We're fortunate that we're the broadest open-source business application project on the planet today.

SM: How did VCs react when you pitched this vision to them? JR: Nobody had ever funded a commercial open-source company, much less a commercial open-source application. I had to make sure they understood that we were a for-profit open source. We did a $2 million round within three months from Draper Fisher Jurvetson.

SM: Draper Fisher Jurvetson has spawned many such projects which are experimental and do not have an extremely polished business model. Hotmail and Skype were Draper Fisher Jurvetson companies. JR: They're a smart team. They understand the notion of valuation

without revenue. I don't think they were open-source experts, but they did understand the strengths of our team. Since then we've raised $46 million in venture capital.

SM: What were the milestones that pushed you to take more money? JR: We believe project-powered enterprise applications are the next generation of public tech enterprises. It has always been our mission to become a public company using a modern business model. To do that you need to raise capital and move faster than you otherwise would.

We didn't have a sales channel. We had a very small office in a software incubator. We took VC money to allow us to become a market leader. Now we have over 4,000 paying customers, we're in more than 30 countries, and we have 170 employees.

SM: What does the anatomy of a project-powered enterprise application company like yours look like? JR: We have a traditional engineering department. We also have project management, but there's a difference in the way we receive requirements; our requirements come from all over the world. They come from paying customers and from nonpaying customers. If you were to compare our financials with those of our predecessors, we're blowing them away in terms of capital utilized to grow a company.

I think Salesforce and AOL had similar business models. If you look at their stock trends and their basic tenets of how the companies are built, that is, being monolithic walled gardens with extreme sales and marketing costs, it's hard to deny there are similarities. Those business models were revolutionary in their time.

SM: By 2005–2006, you started seeing a ramp in the adoption of your code base. Were you monitoring revenue growth or user adoption? JR: We had incredibly fast growth. Revenue was what gave us confidence as we moved forward. By selling subscriptions, we generated revenue within six months of founding the company. We only do subscriptions – we want to earn our keep every year.

SM: Can you take us through the process of building your sales team? JR: People started calling from all over the world, so we built four different sales channels: an e-commerce engine, an inside sales team, a channel sales team, and an enterprise sales team. We built them all from scratch.

I used the same approach to sales as I did in the development of the software: we let people do sales in areas in which they were strong.

We've made our sales numbers for 16 quarters in a row. And we've developed a fair and just ecosystem. People agree with the way we generate revenue. They recognize that without reward you're not going to get great software. So we've earned the right to generate revenue.

SM: How has the financial crisis affected your business? JR: What we saw before the correction was that while people were aware they were overpaying for software, they were not changing because it worked. Now they're looking deeper at their costs, top to bottom, as well as their customer experience. What are we getting in return? What are we paying for? That's when our free alternative helps.

This is my third recession, and I've been in the same software segment each time. I always

figured people would buy sales force automation software because they want to be more efficient, but that's the last thing they do. They go right back to spreadsheets and stop the expensive stuff. What's different this time around is that there's now a free database, a free operating system, and a free CRM.

SM: Since you pioneered enterprise-grade open-source business applications, what else have you seen come about in that genre between 2004 and 2008? JR: Anything in SaaS, on demand, cloud computing, whatever you want to call it. It has grown like a weed.

What's missing? Applications. I'm talking about big providers building big infrastructure on demand. There's no reason I can't buy my BlackBerry from Verizon and then get my CRM from Verizon as well. But telecoms aren't in the software development business. We're in the middle, and we don't care. If you want to buy SaaS from us, great. However, we will allow our partners to run it in their environment.

SM: What else has developed in your genre? JR: If you look at commercial open source, which is the category we put ourselves into, there are about 20 companies. Zimbra had the same model as ours and was founded at the same time. It was sold to Yahoo! for $350 million. XenSource was also acquired for $500 million. JBoss was pretty close.

There really aren't a lot of comparables. The IPO market is dead and will remain dead for another year. MySQL was going to be the first public open-source company and got purchased for $1 billion. That should give us some idea as to the valuation of these companies. Sugar is now the biggest one standing.

SM: Are you familiar with CollabNet? JR: They're actually one of our customers. They arose out of the initial Linux movement. CollabNet is really strong. I think there was a gap of about two to three years where open source was not funded very well. During the dot-com boom, there were a lot of different Linux distributions. Then we had a dark winter. Companies like us eventually came out and said, "We don't care. We love Linux, we run on Linux, but we are not Linux. We also run on Windows and Mac OSX."

Linux is still the foundation. On the other hand, you don't have to run Linux to run Sugar. These are interesting times. The collapse of the stock market has slowed things down – we thought we'd be in position to file next year.

SM: Are you going to do anything differently now that you are not going to file next year? JR: We have a very good cash position, a very strong balance sheet, and a very strong recurring revenue stream, and I think the market that is most susceptible is enterprise sales. Open source is kind of an underworld. It's blogged on, but there aren't a lot of journalists covering the movement – which projects are gaining strength and which are losing. The proprietary world is all about PR firms, events, and press.

As a society we have tremendous energy challenges ahead of us that I think will radically affect the amount of time we spend face to face. As a result, technology companies that are dependent on sales forces and screen marketing and lack the base technologies – that business model will be in trouble.

Open source is kind of like what the Japanese did to Detroit in the 1970s.

Detroit was building these big, proprietary, monolithic cars that would last 50,000 miles. The Japanese started building boring cars that were cheaper, lasted longer, and got better gas mileage. Everybody laughed at them in the beginning, much like they initially laughed at open source.

SM: On a personal level, how has dyslexia impacted your growth and success? JR: When we got our first patent at Sugar, my name was typed wrong. It was "Johri." I was a bit upset about that, and then I thought about it longer. If you look at it, the "ri" looks like an "n" when they're all lowercase letters. How ironic life is; Mother Nature has a sense of humor.

In a nutshell, I'm mathematical, but I also like to write. I'm not good at either one, but I am very good at doing both at the same time.

Perhaps something like dyslexia forces you to take the path less traveled. Bill Gates doesn't have a college degree that I'm aware of. Steve Jobs doesn't have a college degree that I'm aware of.

> ***If you look at the most successful titans, they tend to come from nontraditional roots where they're challenged in one way or another and forced to find an ulterior way to accomplish their goals. They're forced to find a different way to get there, and it usually ends up being an innovative way.***

I think standardized tests are good, but you can really miss out on a lot of smart people – people like me, people with dyslexia. So I think net/net it probably made me perceptive in a different way, and that's potentially the basis for something new. Sugar was an experiment.

SM: All pathbreaking startups are experiments. JR: Five years ago we were wondering if anybody would like the software, if they would download it, and if they would buy it. Then we wondered if we could get VC money. The answer was always yes. Even internationally. You don't need an army of field sales people. People will download it and internationalize it for you.

What's unique about our business model is that it's all about the software, it benefits the end user, and it's different from the traditional way the game is played. I'm not saying others are playing wrong, just that times are changing. I like the pull and energy of people making their own decisions. We're at the beginning of a new era.

SM: Thank you, John. Inspiring story!

Free to Innovate

Every day entrepreneurs I speak with share ghoulish stories of how difficult it has become to fund their dreams. But entrepreneurs don't necessarily need outside funding to innovate. In fact, they retain more control over their companies if outside investors, like venture capitalists, steer clear.

Paul Kocher is a prime example of an entrepreneur who bootstrapped his company, building it on his own terms. In 1995, he founded Cryptography Research, a San Francisco–based firm that solves complex data security problems. Today, privately-held Cryptography has 23 employees and $30 to $40 million in annual revenues.

Not having outside investors pressing for growth at all costs has allowed Kocher to pick and choose the problems Cryptography addresses and the technologies it works with. In fact, in the process of solving these problems, Kocher's team often comes up with original innovation, therein generating a rich portfolio of its own intellectual property.

"I'm not someone who is motivated by money," he says. "There are many interesting things that you can do to change the world, and while money may help in some cases, if you give me the choice between a really interesting project and a well-paying project, I'll choose the interesting project."

Kocher owns most of the equity in Cryptography, the balance being held by his colleagues, past employees, and a few advisers. I asked him how he sells prospective employees on the company's compensation model. (At a venture-funded company, for instance, you have a four-year vesting schedule before trying to sell the company. At the time of a successful exit, employees with stock options can cash out.)

Kocher's response: "We sell off pieces of technology we've built. We sold some technology used in Blu-ray content protection to Macrovision for $60 million. As we're a privately held company without external investors, a lot of that money goes to the employees. That ended up being a really nice payoff for a lot of folks. It's not like the company has gone public and is now off in the wind. This can happen over and over."

But Kocher tries not to promise employees too much. Base salaries are lower at Cryptography than at some competitors. But in a good year, annual bonuses are far greater. Indeed, a $60 million bonanza shared by 20 people is a nice feast – and if it happens every few years, I don't think anyone will complain!

The more subtle reason for my enthusiasm is that this structure offers a framework for technology innovation that would otherwise go unaddressed. Venture funding would prevent entrepreneurs from going after such sub-billion-dollar business opportunities. Opportunities which, from an entrepreneur's point of view, number in the hundreds and thousands, just waiting for the right people to build for themselves very nice $5 million, $10 million, even $50 million businesses. Too small for the venture financing model, but certainly attractive for the creation of both personal wealth and jobs.

As we look at the innovation ecosystem from multiple angles, Paul Kocher's business model offers an alternative that technologists can easily adopt once they find a set of customers willing to pay for the expertise and domain knowledge they offer. In other words, as long as innovation can attract customers, the rest of the barriers to innovation, especially capital, become navigable.

Paul Kocher, Cryptography Research

Paul Kocher prefers independence and intellectually challenging, innovative work over money. In structuring his company, he has worked to preserve both. Great innovators quite often share Paul's way of thinking, which is why this entrepreneurial model – structured around intellectual property and royalties rather than venture-style exits – should be keenly studied.

SM: To start, take us through your background. Where are you from? PK: My mother is Canadian, but whatever accent she passed on has mostly been beaten out of me. I grew up in Oregon, where my father was a university professor. He taught physics, but I don't know the details. My parents were very hands-off. They opened the doors, let us go get muddy, and cleaned us up afterwards. My dad brought home lots of computer equipment from his office with no manuals. I learned computer science backwards. Today you start by learning high-level languages like Java. I started with assembly because that's all there was.

SM: What year was that? PK: That would have been around fifth grade, so sometime around 1982. I was not athletic, so the computer was much more interesting than going out and getting pummeled. After high school I went to Stanford – I was planning on being a veterinarian. I loved animals and worked at a clinic in high school.

However, around sophomore year I ran out of money. My parents would've helped, but there are always strings attached when money comes along. I ended up getting work at RSA Data Security. I worked there while I was in school, and I also got some consulting projects from Microsoft doing security evaluation. At that time the CD format was the new thing; hundreds of floppy disks could be stored on a single CD.

SM: What a sense of freedom! PK: There was so much data nobody knew what to do with it! Microsoft was trying to figure out if they could put all of their programs on one CD and do various try-before-you-buy business models. I was reviewing these for them. They'd send me the product, and I'd break it and then send them a note telling them how I did it. I didn't charge them enough money, but it did help pay my way through school.

When I graduated, Martin Hellman had a consulting project he no longer wanted, so he sent it my way. My vet school plans went on ice.

The nice thing, or horrible thing, about security is you never know if you got it right or not. You can find out later that somebody broke your systems, but when you're launching a program, you generally have no idea if you've done a good enough job.

Unlike most areas of computer science, in security you don't go for the cheapest solution. You go for the most conservatively designed and robust one. It connects all of the threads together: the user interface, the code, the business model, the operating system, and the hardware. Everything can screw up your security, so you have to worry about it. The same amount of ambiguity you have to deal with in veterinary medicine is also dealt with in security. You really have to solve a problem with very limited information.

SM: Interesting. Our dog is quite old, and he has all sorts of problems. You don't do an

MRI or all the other things you would otherwise do to diagnose a human. The vet is all trial and error. That is a good comparison to your line of work. PK: It certainly requires a lot of instinct. I may be drawing parallels more than I should, but I think there are similarities.

Once I had those consulting projects, I hired a friend to work with me. He was someone I knew from seventh grade, and he was doing a lot of interesting computer work.

SM: What was the business model for your new company? PK: It was clear that the consulting model was good for stability, but I like to shake things up. I started putting all the extra money we could into R&D and patents. We started looking for interesting areas and refining a business model. We did consulting work to find out what the real challenges and needs were. For example, we would be hired to evaluate four or five different products, which was great because we got paid to find out who the right people were and what their outstanding needs were. We then did R&D to refine and meet all their needs.

SM: What year did you start this? PK: This was in 1995.

SM: I am assuming you were dealing with Internet and network security? PK: It was all starting to become an issue. The security industry is dramatically bigger now than it was then. People were still figuring out what the Internet would look like.

SM: What was the first problem domain you found to build IP around? PK: The very first one we worked on, which we really only made money on when we sold the patent, was document security. Right now there are very few tools available to someone looking to improve the security of a document. You can have a physical paper with a signature, which tells you that the correct person may have signed the paper, but this doesn't tell you if the document has been modified or not. The document can be notarized, but that doesn't tell you the full record of the contents of the document. The idea was to build a fax-based service where you could fax your document and have it archived. You would then receive a receipt, which could be incorporated into the notarization process. In the end, the business model didn't work – the sales process was too complex for us – but we did make money when we sold the patent.

SM: You did all of this while you were still making money consulting? PK: Yes. We've been profitable every year.

SM: How many people did you have at that point? PK: We have 21 now, but at that time we had three. We were still small. I completely stumbled into the idea of running a company. Everything has been very opportunistic. We pick a direction, start going that way, and then end up changing paths. I didn't know any venture capitalists, which is a good thing; otherwise, I may have tried raising money.

I'm horrible with dates, so I could be off by a year or two, but a couple years after I started, I did some work on the problem of how to prove credentials have not changed. You're probably familiar with Verisign and all of the hype there, which has subsequently deflated to a large degree. One of the problems I was looking at was how you could prove the certificate you got from somebody hadn't been altered or changed since it had been issued. Typically, these are issued for a year or two before they expire, but a typical person doesn't stay at a job for a year or two. You cannot be sure that someone you've received a certificate from today will have the

same attributes in six months because that person could quit.

We built an efficient technology that allowed you to not only give someone your certificate, but also prove that it was current and had not been revoked. That technology has become the core for Valicert, which I co-founded.

SM: So you kept your consulting practice while you did Valicert? PK: Yes. It was the opposite of the gas-pedal-to-the-floor, go-public-with-a-crazy-valuation, then-fall-before-being-acquired model of raising money.

Going back to the chronology, one of the projects I did was to assist with the design of SSL3. Taher Elgamal brought me in for that entire project. Netscape had an old version of a security protocol that was getting beaten up in academic papers every month. It was causing people to lose faith in the idea that you could safely send your credit card information over the Internet. That was obviously a big problem for e-commerce.

The redesign of SSL was a crash project where Taher called me and said, "We have to ship a product in a month or so, and we need a new protocol for it. Can you come and do it?"

SM: What were your terms with Netscape? Was it pure consulting, or were there royalties? PK: It was a pure consulting project. Nobody got royalties. It's a free protocol, and it needs to be that way. If there had been a need to pay one penny for the protocol, it wouldn't have taken off. It's an ingredient that helped build the Internet.

I'm not someone who is motivated by money; there's a limit to how much you can eat. There are so many interesting things you can do to change the world, and while money may help in some cases, if you give me the choice between a really interesting project and a well-paying project, I'll choose the interesting project.

SM: The advantage of your business model's being free of VCs is that it allows you to make those trade-offs. PK: It does. It means our business is probably smaller than it would be if VCs were involved, but it's also probably far more solid. The equity in my company is owned by current employees, past employees, and a few advisors. But I have the majority equity, which means there's nobody telling me what to do.

I do have to be careful with the freedom that brings. I know people who've had similar freedom and made bad decisions.

There's a real benefit to having people around who are willing to tell you when you're being crazy.

Having power and nobody who tells you when you're doing the wrong thing can destroy an organization. When we make a decision, it's very much a consensus decision. When we hire an employee, I try to get as many people as I can to interview that person, and any employee can say no.

SM: Your structure indicates that this is not a company you are going to sell; rather, it is a company you are going to enjoy. Is that a safe statement? PK: If there's somebody who wants some of the technology we have and won't ruin the culture, I wouldn't necessarily say no.

SM: When you recruit employees, how do you sell them on your company? The venture

model is very simple: you have a four-year vesting schedule, at the end of it you are expected to sell the company, and the person then has the stock options to cash out. PK: In terms of the economic side, we've sold off pieces of technology we built. We sold some technology used in Blu-ray content protection to Macrovision for $60 million. As we're a privately held company without external investors, a lot of that money goes to the employees. That ended up being a really nice payoff for a lot of folks. And it's not as though the company has gone public and is now off in the wind. This can happen over and over.

> ***I'm someone who tries not to promise too much. Employees are compensated with the success of the company.***

Just about everyone's base salary is lower than what he or she could get somewhere else. But at the end of the year, we do bonuses that are historically higher than what people would be making elsewhere. Though if we have a crappy year, they don't get that bonus. People interviewing get a sense of what the past has been like, and the model is one where, given that track record, people are comfortable coming in.

SM: What kinds of people come to you, and how do they find you? PK: Hiring is our most difficult problem. If I were to pick the thing that most limits us in doing the things we want, it would be finding people who simultaneously meet our three criteria: we want people who are technically brilliant, communicate well, and are fun to work with. It's frustrating for us because we find plenty of people who have two out of the three. But it's really, really hard to find people who have all three attributes and to recognize that in the interview process. I'm sure we've interviewed people who have all three, but we just didn't recognize it.

SM: Trying to evaluate all the capabilities of a person in a matter of hours is very difficult. PK: It's also a high-stress environment for that person, so seeing how someone behaves in that type of environment is interesting, but 99% of the time on the job, we don't want people who are stressed. We want them to be comfortable. We want them to do what they really enjoy doing.

SM: Are people coming to you, or are you searching for them? I ask because there is a lot of naïveté in the business world about where people seek work. PK: Usually the people we hire aren't straight out of school, but we have made some exceptions. They're folks who are already involved in security. Word of mouth plays a big role.

SM: Let's move back to the chronology of the company. After you did the SSL project at Netscape, what was your next move? PK: We'd done several hundred different projects for different companies. Most of them are confidential. Typically, someone who was at a company that was a client of ours but has since changed jobs calls us in. In their new role, they call us in for their newest challenge. The mixing in Silicon Valley is just great for that. People switch jobs, and that plants seeds for us. Usually the situation is that a company has rolled something out and it's being attacked, or they're building a new product and they bring us in to do a design review.

About the same time as the SSL project, I started an effort internally to look at a way to secure semiconductors. I wanted to figure out how to put keys in them that could not be pulled out. That remains one of the areas I'm really fascinated by, for many reasons. The core problem is this: how

do you make something that can prove its authenticity or do something that a person cannot copy? Cryptographically it's a straightforward problem. You put a key in it, and you put an algorithm that uses that key to decrypt data, but the key itself should not be something you can solve mathematically.

When somebody starts prying the chip apart or measuring the power consumption of the chip to observe variances and make inferences about what the key's given power measurements might be, it becomes an incredibly difficult problem.

SM: I do like your model of creating a body of intellectual property and then letting somebody else do the legwork. Talk a bit more about your process. PK: Historically, people have followed a model where the research is handed off to the implementer, who hands it off to the product-marketing folks to see if there's a business. But the approach I've always liked is when we try to get continuity. When people have ideas, I like to see them stick with it all the way through the process. With the power analysis work, Josh Jaffe and I have done the technical work all the way through.

SM: Are there anchor clients you work with on the power analysis work? PK: We've announced a bunch of licensees. The two top manufacturers are both licensees, and they make a billion chips a year on our license. Anywhere you're trying to build a chip that keeps its keys if it falls into the wrong hands is an ideal case for our solution. There's a new US government standard coming into effect that defines the standard for any cryptographic gear the government buys – it requires these countermeasures in those products. There's a whole new group of companies out there that we'll be dealing with, that we'll start to deal with as they find ways to meet these requirements. The adoption of the countermeasures is being driven by the standards of the purchasers.

SM: What do your IP licensing structures look like? PK: My favorite is to go to someone who's losing a ton of money. With customers like that, it's a no-risk proposition – we only get paid if we solve their problem. The first area where we rolled that out was paid TV. The security budget per chip there was rather high, so it made sense. The cost per chip could pass $1, but Moore's Law is driving those prices down.

Today, we can build something for a couple of cents that would have cost a dollar a year ago. Transistor costs are falling, and you can also pack something in a corner so that people don't even know the impact of it, whereas before adding 30% to a chip area was a big deal.

We're rolling out similar technology for other areas where there's low cost per unit but high volume overall. The first project we did in paid TV had 50 million chips. That's a pretty good number. We probably ended up getting $0.50 a chip. For some projects now it's even lower per chip, but with even higher volumes. Any time you have a product where the price you pay for it is much more than the manufacturing cost, you'll have a problem with counterfeiting or attacks.

This applies to IP-based businesses. The replication cost of a DVD is a fraction of what it costs to put the material on the DVD. Having a genuine product able to cryptographically attest to its authenticity is important for the business model of the manufacturer. The economics justify a certain security budget, which may vary widely between products. The long-term goal is to get cryptographic chips into these applications where that chip's security can keep someone from counterfeiting the entire product. We've done this successfully in the paid TV market and are now working towards ever-lower price points for other markets. There's no

reason that manufacturers cannot put something into their products which attests to its genuine nature. In that scenario, when Nike shoes come through customs, their authenticity can be verified, and retailers can be sure they're not selling knockoffs. The key is to do this in a way in which the authentication itself cannot be copied.

SM: Essentially you are enabling brand protection, right? PK: Brand protection, quality assurance, etcetera.

SM: How big is this business for you? These are potentially huge volumes. PK: Our goal is to get a few cents a chip, depending on the volume. At the end of the day, we end up getting 10% of what our customers save. I want that to be a higher number. Still, when you start with a company that's losing hundreds of millions of dollars a year, the improvements can be significant amounts.

SM: With 23 employees, how do you target revenues? PK: My goal is $4 million per employee annually. That's what we've been shooting for long-term.

SM: Based on approximations, would you say that you are a $50-million-a-year company? PK: This year we'll be somewhere between $30 and $40 million. It's not something I worry about too much because our costs are low.

SM: What has prompted you to seek a broader communication outreach? PK: Hiring is one of them. The people we want to reach are those who are the hardest to find. I'm also very concerned about the patent system. The R&D industry is being lost right now. Companies like ours, that treat employees very well, are competing in a vanishing environment. Someone with similar ideas today would have no chance of repeating our model because the costs are so great. You have to have a huge amount of money to litigate today, and if you're not ready to litigate from day one, people will bury you.

We've had people try to do that to us, but we have the money to fight. The idea that the quality of your lawyers and your willingness to go through expensive litigation is what is required for someone to build an R&D business is just wrong. We're an unusual model, but one which works well. I wish other people did it.

SM: One of the reasons I wanted to drill your story is because your model is unique. There is a cookie-cutter thought process in Silicon Valley that demands you go out and raise venture capital. I think that there needs to be an exploration of different models. PK:

> ***The VC model is great if speed to market is important. However, a lot of businesses get destroyed because they go too fast. I think patience is key.***

You need to put out lots of buckets and see where the drips land.

SM: Timing is complex to get right. PK: In hindsight, people like to say they got it right if they made a lot of money. Really, they just made money. They still may have gone too slow. There are so few data points that I think it's very hard to say if it's luck or skill.

SM: Success is probably a good portion of both. PK: Probably. There are certainly huge things that helped. If I didn't land in Silicon Valley at the right time in life, there's no way I could do the things I'm doing now. Also, I started out when the boom was going on, which was complete coincidence. However, perhaps I would have been even happier as a veterinarian!

SM: Thanks, Paul. And good luck!

Advice for Laid-Off Engineers

The year 2009 began for many on an anxious note. Layoffs were everywhere. Foreclosures stalked them from town to town. By the fall, unemployment in America hit 30 million, over 10% of the population. But life goes on. Bills come in, and mortgages come due. Looking for a job in this environment is no doubt a daunting, if not impossible, task. Against this backdrop, I want to highlight several entrepreneurs who managed to turn adversity into opportunity during the dot-com bust.

Kansas farm girl Michelle Munson is one such entrepreneur. Munson bucked her family's multigenerational agricultural tradition – raising cattle and growing wheat, corn, and soybeans – to study computer science. After a brief stint at IBM**,** she went to work for two technology startups in a row. Both went under, and Munson was laid off through no fault of her own.

"At the end of my time with the second company, I was burned out on startups," she recalls. "It was an ironic situation because startups are what I love. I poured myself into these companies. I worked almost as hard for them as I do now. But I was very disillusioned because I felt both had mismanaged their direction and their placement. I couldn't imagine working for someone else again."

So she didn't. In 2003, with $20,000 in seed money from her parents, Munson started her own venture, Aspera. She brought aboard her mentor, engineer Serban Simu, and the two developed software that transfers large data files at high speeds.

Fast-forward five years. Emeryville, California–based Aspera now has 400 customers and 42 employees. Munson and Simu took control of their destinies and built a profitable, multimillion-dollar company. What's more, they have maintained full control as Aspera remains a self-funded venture.

Munson's message to the glut of engineers who have recently received pink slips is this: "Look at Aspera. The company I was at canned us all, and that's how I got here."

If Munson's story is one that inspires engineers to look for entrepreneurial opportunities within their own profession, I also encountered some charming stories of laid-off techies who pursued interests as diverse as wool and bike seats (for dogs).

In 2002, during the dot-com bust, Laura Zander was laid off from her San Francisco software engineering job. The economy was just as precarious as it is in 2009, so job prospects didn't look promising. Instead of plunging back into the slumping tech industry, she decided to open a yarn shop in Truckee, California.

After investing approximately $30,000 from their savings account, Zander and her husband, Doug (a software engineer at the time), started Jimmy Beans Wool. Initially, Doug continued his day job while he built the company's Web site with an integrated inventory management system and online shopping cart. After three years, when the entirely self-funded online business was large enough, Doug quit his job to work for JBW full time.

Profitable five months after it started, JBW now enjoys annual revenues of approximately $2.1 million. The company boasts 40,000 customers and gets 150,000 unique visitors and 1.2 million page views per month. This revenue, of course, is built on wool, not chips or code.

And then there is Glen Malmskog, an electronics engineer who started his own business to escape the ups and downs of the tech industry. Laid off in 2006, he decided to make the most of the situation and started Saki Seat, which makes bike seats for dogs. The entirely self-financed

Saki Seat was born when the recently laid-off Malmskog was advised by his doctor not to rollerblade anymore due to a degenerative back condition. Malmskog, a sports enthusiast who had been rollerblading with his dog Saki for several years, wanted to find another recreational sport they could do together. But before a biking holiday, Malmskog explored his options for a pet seat and found nothing. So he designed the Saki Seat himself. After a flood of positive feedback on the seat, Malmskog developed, patented, and began producing it for a wider market.

Today, a seat retails on the company's Web site for $49.95. Over 400 seats have been sold so far, and in spite of the current economic downturn, sales doubled in 2008.

Today these stories are especially important as evidence of how high the human spirit can soar. In the face of adversity, it is human endeavor alone that can turn the tide. Of all the options before us, the one that presents the greatest potential as a solution for economic turnaround is this: entrepreneurs get to work, innovators apply their creativity, and in the process companies get built and jobs get created.

To find work for 30 million people, this process needs replication at a monumental scale. But necessity being the mother of all invention, my hope is that this great recession will spawn an unprecedented level of entrepreneurship and innovation, positioning us for a vibrant, robust future.

Michelle Munson, Aspera

After Michelle Munson was laid off from her second company, she continued to hear from former customers detailing the same ongoing problem. Then a chance encounter with one of the top sales reps at her former company confirmed her hunch that the problem she had identified was broadly felt in the customer base. The solution to that problem became the basis of Aspera.

SM: Michelle, where does your story begin? MM: I grew up in Kansas, on a farm. My family is a five-generation farm family that raises Angus cattle as well as wheat, corn, and soybeans. There's a long-standing family tradition in both the line of business and the location. That's an interesting point with me: I was accepted to MIT, but I went to Kansas State.

Growing up, I liked all subjects but had a particular interest in math. I also enjoyed English. I was very serious about school, and by college I had scholarship opportunities that made it possible for me to go to school anywhere. I chose Kansas State for a couple of reasons. I had a full-ride scholarship, and I'd taken several courses at the university during high school and had great professors. I was convinced that this could be a way I would be happy.

After that I went to graduate school. I did a Fulbright at Cambridge in the UK. Between those two, I was involved in starting an ISP in this rural area. There was no AOL access because it was too small for AOL to justify putting in service.

I took a year off to run it, but it was a very small business. It was totally different from a technology business like we have at Aspera. It was an interesting thing to do and to better understand what the Internet meant. But there was no clear future at all, which solidified my desire to go to graduate school.

SM: How long did you operate the ISP? MM: One year. We kept it for three years and finally sold it to another ISP when I came back from Cambridge.

It wasn't very impressive. It had 700–800 subscribers; it was entirely local. It was nothing like a serious business. We sold it because there was clearly no future with it.

SM: But you learned? MM: Absolutely! It was an intersection between a business and a community service project for a rural community that otherwise wouldn't have had access to the Internet. There were 10 people who helped fund it and get it put together. I volunteered my time to work on it. The second part was it introduced me to an entirely new world. I ended up coming out to ISP CON here in San Jose. I took that time to visit Stanford and Berkeley. It just whetted my appetite for my future.

I then went to Cambridge for a year and did a really neat program there in computer science.

SM: Up to that point you had been in Kansas City the whole time? MM: Yes. I had traveled quite a bit growing up and had been to lots of different summer programs, and my parents traveled internationally, but we had never lived anywhere else.

And I almost stayed in England. I considered joining the company my master's thesis advisor had started. But I got offered a job with IBM at a research center, and then I moved to Silicon Valley in 1998. That's essentially what led to where I worked, what my expertise is, and

ultimately to Aspera getting launched.

SM: What happened in 1998? IBM was not where the action was. MM: What an apt question. I stayed a year and a few months. On my last day, we had a town hall meeting. The theme was on retaining people. I was shrinking in my chair as the speaker gave this lecture. My cohorts were looking at me – they knew it was my last day.

But my time there was a great transition to Silicon Valley. It's how I got my next two jobs. It's also how I got introduced to the technology/intellectual community that I consider my peer group. I ended up doing conferences and retreats with the Berkeley Systems Group. I met folks from the Stanford Systems Group. I was young enough that they treated me like a grad student of their own, and I got to know a lot of key people.

The first job I had was at a startup founded by one of the Berkeley professors who recruited me into it as an engineer. It was called FastForward.

SM: What did they do? MM: An application layer multicast product that was ultimately implemented into appliances. It was positioned at that point, 1999–2000, as providing high scalability streaming support. The twist on that technology is that it's interesting straight out of application level multicast, but it was before its time. This was one of my first realizations of the gap between concept and reality.

SM: Where does your interest in startups come from? That is not what a lot of people expect from a Kansas farm girl. MM: On the surface perhaps not, but that's exactly where it comes from. My dad built our family farm business into something substantial. He operates that way. And my mother is a university professor, which isn't an entrepreneurial life, but it's an independent life. Both of my parents are highly independent people, and they raised my brother and me to be independent. My brother runs the farm and has his own business now, selling premium Angus beef. We're also involved in banking in Kansas, which these days is a technologically-driven business as well.

When I decided to start Aspera, they were the people who were the most important. It didn't seem crazy to them at all. They kind of expected it.

SM: After your FastForward experience, what was your next step? MM: I went to a very similar startup in the same application layer networking technology area. It was started by colleagues out of the Berkeley community who were coding theory experts. It was application of information-coding theory for transport. It covered the area we're in now, except it was encoding-based. The main application area was reliable multicast, but in this case scalability was in a different dimension. It was for large numbers of receivers who needed to receive forward streams or data transfers without having much of a back channel.

These days you could think of it as video distribution over an unreliable connection for a large number of diverse receivers. But they also had issues matching what they were doing to the marketplace.

SM: What year was this? MM: That brought us up to 2003, which is the year the Aspera concept got going.

SM: What was the Aspera concept born out of? MM: Two things. First, at the end of my

time with the second company, I had a consulting engagement with one of their customers. They were trying to deploy this company's forward error correction technology for point-to-point transport. It was ill designed for the task and technologically did not work very well. Productization was terrible, but the customer, who was a media company, really needed it. The customer would talk to me, and it was obvious from my time working with them that there was a need, and yet what the company was offering was not the right solution. One of them pulled me aside at a dinner, and while they didn't go to the heart of what Aspera is doing with higher level file transfer workflows, this person did emphasize how a solution to their challenge was needed and asked why we could not do something about it.

The second thing was that at the end of my time with the second company, I was burnt out on startups. It was an ironic situation because startups are what I love. I poured myself into these companies. I worked almost as hard for them as I do now. But I was very disillusioned – I felt both had mismanaged their direction and their placement. They both went through the dark side of failure, firing everyone, going through hell.

But I wasn't interested in going to a big company; I really wanted to be a part of an entrepreneurial endeavor. That's why I joined two startups to begin with. Finally one evening I was sitting in my room, and it dawned on me that I needed to build a software layer transport that was focused on this problem that folks in digital media had.

SM: What was the problem the digital media companies were facing that you wanted to solve? MM: I knew it was a problem in application layer networking, which was something I had always had an interest in. I liked the theoretical underpinnings of it. I could see there was a layer that was unsolved. They needed a software layer that would allow transfer of data between sites over distances.

SM: Was the problem large file transfer? MM: At that point in time, all of the applications I saw used were large data files. Media companies had large video files they needed to move, and I thought the transport existed; I'd been through companies that claimed they had solutions for this. I also thought there were open-source ways to address this with UDP transports, peer-to-peer streams, and parallel stream transports. I took that inclination and started on a path that was more focused on workflow.

In my mind, the technical solution was solved, and the problem was in the upper layer of the workflow. I did a project where I built a small software application and took it to NAB in a science fair/interoperability demo. I used it as a marketing exercise. It became a little prototype that I could show. And as I went around the show and talked to people about their opinions, I found out this file transfer problem was in fact affecting more companies in the industry.

Then a second event occurred that reinforced my idea. A very successful salesperson in my prior company came to me and said, "You know, we really needed to have a software-based transport that allowed us to move large files with these characteristics," and he put it in salesman lingo.

> ***This was all reinforcing and validating my concept. I don't feel like I initiated any of this. It all lined up.***

That I decided to do it was the function of my liking entrepreneurship, having an epiphany moment, and having a strong desire to not work for someone else again.

SM: Necessity is the mother of all invention. MM: Yes. I went along this path for about four months, starting in November, and NAB was in April. I came back and talked to Serban. He is my co-founding partner, my best friend, my engineering mentor, and the person I knew could answer all of these questions. I told him the situation, and I described the shared problem and the gap all companies faced. I felt we needed to look at the fundamental problem and see if it was solved. I still wasn't working. Everybody who knew me thought I was nuts because I had no employment and I wasn't doing anything other than pursuing this.

SM: How were you financing all of this? MM: I lived off savings; I lived off very little for a year. My dad kicked in $20,000.

SM: In early-stage startups, $20,000 is very useful. MM: It sure was! That was all I needed for this type of thing. I then did an independent study of what Serban and I thought were the ways of solving this problem. I evaluated what was available from other companies and what was available via open source. The deeper we looked, the more we found there was nothing that solved the underlying transport problem at the technology level.

We analyzed everything and set out a certain set of design criteria that we wanted the transport to be able to do, and it did not measure up. I then started to look at the specifics as to why, and then we set up a set of experiments that looked at network delay and packet loss. This was all done out of my house, completely in the background, without any structure. I was doing it, and Serban helped me structure it.

By the time we were partway through, it was clear to me that we should simply focus on this problem. We found the best open-source incarnation of what we wanted to do, found its weaknesses, and that became the base. The specific weakness that it had in terms of dealing with delay and packet loss was an unsolved problem.

SM: You were able to find a starting point in the open-source community? MM: I found a good model from a different domain that we experimented with, and it worked well. That was the point at which we started making the protocol. At the point at which we started making the protocol, Serban was still working, and he continued working at his job for the next six months. He left it in December of 2003. We launched the company in 2004 – it took us a full year to get the protocol developed.

We basically worked on that, and by the fall of 2004 we had two opportunities to present it. The first opportunity was with the media company that knew me and had pushed me in this direction, Warner Brothers Studios. The second one was a defense contractor that became our first customer. They were both impressed. The defense contractor benchmarked our prototype software, which was just command-line software, and they said they would buy it if we ported it into Windows. So we started porting it into Windows as fast as possible.

SM: Were you then able to grow organically from that first customer? MM: The most significant day was the notice of our first purchase order on February 4, 2004. It was a $20,000 purchase order, which I think was end-of-year money for this defense contractor. They thought they would throw it our way, and that's what we used to get launched. That's how we went to our first NAB as a company, it's how we got our first business guy, and it's how we got our next batch of customers.

Warner Brothers became our first media customer that summer, but it was ultimately a

different group that made the purchase. It was those two evaluations, the meetings, and the follow-up evaluations that gave us the confidence to push through. We had better benchmarks than anything these guys had tried before.

SM: What were you being benchmarked against at that time? MM: Multiple things. Warner Brothers had TCP accelerators, which were devices they put in line to improve the flow control of TCP, and when FTP was run over that it resulted in a faster transfer. That's what we were up against, and we blew them away.

In the government case I never knew exactly what we were being benchmarked against, but what they did tell me was that we needed to run under heavy delay and packet loss. It was extreme, well beyond the commercial space. That actually turned out to be our advantage. We performed so well that they ended up deploying us in radical situations where they didn't have other solutions. It went into Korea and Iraq after that. They were very specialized scenarios where they had smaller links like microwave or RF links. They would write in with their problems – they were having tremendous packet delay, and they had very dirty and high-loss links. The main issue was a reliable, consistent stream of data.

SM: What was your ultimate design goal? MM: The first problem we aimed to solve was how to make a retransmission machine, a control system that retransmits data at a rate that matches the channel capacity for any packet loss rate over the channel and any delay. That was our design goal.

After we got the essence of it, we began to discover various corner cases where it would begin to break down. It took us the better part of five months to get the basic retransmit algorithm worked out – not only how it would work, but how to implement it in software. That final piece is to Serban's credit. The data structures do not slow down as retransmissions accrue.

SM: Good innovation. MM:

The other great thing is that because we were precise about what we had decided to make, we had an easy way to measure it.

We had our dummy net, which introduced LAN loss. Then we had our sender and receiver, which allowed us to set up experiments where we changed the LAN packet loss. We looked at the rates we were able to achieve, and we had counters everywhere.

SM: You built the algorithm and the simulator in the 12 months prior to launching the company? MM: Yes. That was all I was doing. I didn't have any other job. I was very excited about it, so I did it nonstop. I give Serban full credit for his software engineering. The model is correct and has proven itself. The software engineering is what makes it run so well. Serban designed all of the algorithms and the data structures we used, and he implemented it. He's an outstanding engineer.

We did a second generation on the bandwidth control, which was very interesting. That was also my idea to pursue, but once we got going it turned into the Socratic method with plenty of back and forth. We worked very well together – we've worked with each other so long that this is just a conversation we have all the time, every day.

We would challenge why we were doing something a particular way and why it was different from TCP. Sometimes you do things but you're not sure why you're doing them. You have to constantly reconcile.

SM: What is important is that you found your business soul mate. MM: Yes. At the prior company, we had done a lot of work where we stayed until midnight. And neither of us started Aspera for the sake of having a huge company. We were both extremely interested in this area, and we wanted to control our own destiny.

SM: How did you structure the company? MM: It's very simple – a near 50/50 split. Another very easy decision was regarding our manner of funding. We didn't want outside control.

SM: Did you give your father any equity? MM: He has a bit, as he should. If you looked at our equity structure, you'd find it matches our company history nearly perfectly. About 25% of our company is owned by our employees.

SM: Who are your customers nowadays? MM: They're customers who are largely involved in media. The big studios are the ones you think of, but there are plenty of folks down the chain now. There are video-on-demand players and online aggregators. We have DirectTV, Comcast, EchoStar, Time Warner, and others on the VoD angle. On the aggregators there's Amazon for the video store, Microsoft for the Xbox content, and others. Cloud computing, Amazon, and IBM are all of interest because what they're being asked to do has some digital media emphasis plus a large amount of other data.

SM: Your customers are mostly large companies, so I am assuming you have a direct sales force. MM: Yes. We're almost exclusively a direct sales force, but we're working on building up a channel. Today we have seven people in sales, one person in each region.

The company has changed, in the business sense, like night and day in the past two years. It has doubled in the number of employees each year.

But because we never did the VC thing, we never had a big glut of hiring. The hiring just follows the business.

SM: That is the right way to do it, whether you have VC or not. Since you set up the company as an equity-based structure, you are going to have to exit. MM: Definitely. We would like to sell the company as a strategic acquisition to a company that can make use of the technology. The kinds of companies we're interested in are ones we naturally partner with – the biggest IT companies.

SM: But you are not in a rush to sell? MM: Certainly not. At this stage growth is rapid and fun. But there's a point in the adoption curve where things change. I think it's important for a company like ours to stay differentiated in terms of technology innovation. What we do now is gradually move into the mainstream, and then we'll eventually need to be taken on by a larger enterprise that will be able to do it at volume.

SM: In the process of building the company, how has your life changed? MM: Honestly, I don't know that it has changed radically. I've always been like this. I always

wanted to have a channel of work that lined up with my personality. This is the first thing I've done that fits it perfectly. I've always been excessively busy and ambitious; I've always been stretching.

When I had to make the choice that this was what I wanted to do, it was easy for me – I love it, and it's what I wanted to do. It was so exhausting, especially the way we did it with no money or backing, that it stretched me to my personal limit in every possible way. But I don't feel like I sacrificed anything. This is the first thing I've ever done where I get up and I'm not depressed because I don't have enough to engage in. Resistance in life is what makes it exciting.

SM: What is your message to the tens of thousands of engineers who are jobless in the midst of this crisis? MM: Look at Aspera. The company I was at canned us all, and that's how I got here.

That's the cavalier answer. The substantive answer is that part of it underscores exactly what is wrong with technology companies. I personally feel that the overcapitalized, fast growth/fast turnaround model is self-defeating for technology enterprises. And engineers are the victims. They care about what they're doing and want to make great products.

The good thing is that many new methods have opened up for people to start companies. There is a way to distance from VCs, and it works. I get calls from VCs constantly. I don't have a problem with venture capital, but that model can make businesses grow artificially. My message is that there are other ways.

The other refreshing thing for engineers is to feel the satisfaction of truly making an impact. There is no better profession for affecting the direction in which society is going, but I don't think engineers feel the esteem of what they're truly doing.

SM: Unless they take control of their destiny and really do something that they can completely align themselves with. MM: That is absolutely right. The irony of it is that in the end, the engineers are the essence of these companies. That's where those companies start and end.

SM: There are a lot of things wrong with the way compensation structures and organization structures are set up, where engineers do not get much credit even though they are the ones who build everything. MM:

> ***More and more people are starting to realize that they can take control of their destiny. They can do these types of ventures and succeed.***

There are folks who are technical by nature, who start companies and understand what engineers do intimately. Our company is set up in a way that engineers are fairly compensated for what they do, but Serban and I came into this with a unique perspective because of our background.

I don't know Google that well, but I have always had the impression that culturally, Google is like that too.

SM: There is definitely extraordinary respect for engineers at Google. But they have gone to the other extreme, which is not necessarily recommended either. Google has existed on a complete curve of success and has not experienced failure yet. That is not life. You cannot learn from someone who has never experienced failure. MM: Serban and I always talk

about that with their products. There is no discipline in their ancillary products, which are not successful.

SM: Because they are so absurdly profitable, they can continue to do whatever they want. I am much more interested in your story and the process you described – I think it is much more plausible for people who are sitting there trying to figure out what they are going to do now that they are laid off. MM: I would say it is exactly like that.

SM: Super. I love this story. Thank you for sharing it.
[Note: Michelle and Serban, her co-founder, were married in November 2009.]

Epilogue

Innovation, indeed, is the need of this dark hour. Yet the innovation ecosystem – entrepreneurs, technologists, investors, academia, and government – is ailing. Venture capitalists behave like bankers, no longer interested in high-risk, innovative deals. The government is busy with two foreign wars in Iraq and Afghanistan, while domestically healthcare reform trumps the economy. Entrepreneurs are struggling with a tightening of credit and equity. And academia lacks the knowledge to commercialize innovation. While these systemic dysfunctions need to be addressed, my primary focus remains the entrepreneur's journey, how to tackle the obstacles that obscure the path.

Michelle Munson has the most practical solution. With $20,000 from her father, she put one foot in front of the other, building a profitable company block by block, validation by validation.

A similar story is told by Paul Kocher, who has yet another practical methodology for bringing innovation to bear: using consulting and intellectual property to generate cash flow, he gradually built what is now a sizable and delightfully profitable company. This consulting strategy has been a prominent thread throughout the *Entrepreneur Journeys* series, with such notable examples as Jerry Rawls and Frank Levinson's Finisar, which went on to a multibillion-dollar IPO.

But the bottleneck in the innovation ecosystem remains the lack of big, bold ideas with the potential to become multibillion-dollar enterprises. Ideas that can spawn their own ecosystem of ancillary entrepreneurship like Google, Salesforce.com, Apple, Microsoft, and Cisco. How scarce such breakthrough ideas are today, and how much more scarce the investors to give big ideas a chance to blossom!

In my quest to find options for the aspiring entrepreneur, I have spent a fair amount of time contemplating the role of the university ecosystem as a solution to this bottleneck. Universities must draw upon funds from various government bodies such as the National Science Foundation (NSF) and the Department of Defense. Entrepreneurs looking for financing to bring to market capital-intensive ideas should consider collaborating with university professors who can access these grants and deploy bright, eager talent to bring projects to realization. For with their support the high-risk R&D period can mature properly outside of the venture framework, preserving equity for founders and co-founders. And if the innovation needs a longer gestation period, it will also successfully work around the constraints of the seven- to ten-year fund cycles that VCs have to work within.

In the end though, certain big ideas that call for cross-domain innovation will need to be financed at a PowerPoint stage by venture capitalists. Although few and far between, such VCs who fund formation-stage ventures do still exist, and I encourage entrepreneurs to actively seek them out. They understand the fragile but highly creative formation and incubation stage of a venture. They not only know how to nurture, they enjoy the process just as much as we entrepreneurs thrive on it.

Today, an unhealthy dynamic has taken hold in our industry: VC versus entrepreneur. We must remember that we are part of a symbiotic ecosystem, and the only way this partnership can produce desirable results is if the system supports the interests of both constituencies. Far too often have I seen entrepreneurs raise funding for companies that do not fit in the framework of a

venture model of 10x return on investment. Most are 2x or 3x opportunities, where the venture model has no place.

Just as guilty are the VCs who fund such deals. They shouldn't. However, since the dot-com bubble, far too much money has accumulated in the venture capital industry, so rather than letting it languish, the money is pumped in the wrong direction.

This, though, is changing. In the decade following the great recession, the venture capital industry will likely get right-sized. A smaller, more focused, perhaps more traditional industry will return, bringing back with it a value system founded on pathbreaking innovation, undaunted by the risks in enterprise and industry building.

In this anxious hour of darkness, I am hopeful that a superior structure will rise from the ashes of greed, gold-digging, and value destruction.

In the coming hour of reconstruction, I welcome the value creators' return to power. Entrepreneurs, innovators, leaders, builders – your time has come.

Step in. Step up.

The world is waiting.

Other books by Sramana Mitra
Now available from Amazon.com

Entrepreneur Journeys, Volume One:

Entrepreneur Journeys begins with a simple idea: technology start-up success, and the knowledge required to achieve it, is out there to be leveraged by anyone who is willing to listen. Using her own intimate knowledge of the entrepreneurial world, in this book renowned strategist and *Forbes* columnist Sramana Mitra captures the stories of entrepreneurs that have come before to help those who are looking to learn. Offering readers an inside view of how to navigate an entrepreneurial path, Mitra synthesizes candid conversations with her own incisive analysis, to create a unique set of case studies.

Truly a book that distinguishes itself from the crowded business-book marketplace, Mitra has written a text that is accessible through its story-telling narrative, and at the same time academic in its depth of insight.

Some praise:

"Inspiration awaits readers in this volume of interviews with entrepreneurs. *Entrepreneur Journeys* will provide great insight into the questions and answers behind a start-up business. It succeeds in sharing the enthusiasm and sense of adventure of these technological pioneers."

-Kirkus Discoveries

"Entrepreneurship is not a career. It is a way of life. And what better way to learn about it than to listen to people who have done it, successfully, and to learn about their lives in that fast lane? In a carefully structured set of interviews, Sramana Mitra gives the readers an opportunity to discover their paths, their successes, their setbacks sometimes, and the joys of meeting the immense challenges that have been theirs in a dizzying world where technical competence and management skills have allowed them to leave a deep and lasting mark."

-Professor Elisabeth Paté-Cornell
Chair, Department of Management Science and Engineering, Stanford University

More praise for *Entrepreneur Journeys:*

"Enjoyed *Entrepreneur Journeys* and found it worthwhile. The stories are inspiring and could have a significant influence on a student of entrepreneurship or an aspiring entrepreneur. To paraphrase a trite phrase; 'Yes, you can!' The stories are more than inspiration though. The insightful questions and the thoughtful answers give much guidance, and general wisdom. The book occupies a nearly empty niche between lightweight collections of anecdotes and ponderous but often irrelevant academic research. A great opportunity to come close to sitting with masters and learning directly."

-Barrett Hazeltine, Professor of Engineering Emeritus, Brown University

"Sramana Mitra is herself a symbol of everything that is great about America: a geek, an entrepreneur, an immigrant, a leader. In *Entrepreneur Journeys* she has taken on the task of modeling how entrepreneurs transform economies into resilient, growing systems that provide a future for our children."

-Stewart Alsop, General Partner, Alsop Louie Partners

"Sramana Mitra has gifted us with the first hand stories of industry legends who have succeeded with a combination of fierce resolve, self-reliance, and a willingness to buck conventional wisdom. The next

generation of entrepreneurs has an invaluable reference guide on how their predecessors have succeeded."

-Rick Rommel, Senior Vice President Emerging Business, Best Buy

Entrepreneur Journeys, Volume Two:
Bootstrapping: Weapon of Mass Reconstruction

In a world battered by economic crisis, Sramana Mitra believes entrepreneurship is the only sustainable path forward to a healthy economic world order. And core to the success of entrepreneurial ventures today is the invigorating art of bootstrapping. She takes aim at this essential route along the roadmap to startup success in the second volume of *Entrepreneur Journeys*. Along with her incisive analysis and commentary, she showcases a dozen successful entrepreneurs and their lessons from the bootstrapping trenches. Overflowing with lively entrepreneurial tangents, theories, and behind-closed-doors-experience, the book rises to the level of economic policy discussion while simultaneously offering practical advice from experienced bootstrappers. Important issues like doing more with less, getting started with little or no capital, and validating the market on the cheap are discussed with the likes of Om Malik of GigaOm and Greg Gianforte of RightNow.

Some praise:

"Sramana Mitra's Bootstrapping: *Weapon of Mass Reconstruction* is a book for our time because it's something real out of Silicon Valley. No more stories about legendary VC fundings of startup-to-IPO in six months. In this, the second volume of *Entrepreneur Journeys*, her focus is on doing more with less, in tune with the times. This book has some fascinating histories of the different paths people take to entrepreneurship, and the difficulties they face. I would only have wished each of the interviews to be longer and deeper, because every story is worth telling."

-Fast Company

"I recommend *Bootstrapping: Weapon of Mass Reconstruction* to my MBA students and to anybody planning on, or even just thinking about, starting a business. And also to policymakers. Maybe especially to policymakers. The importance of entrepreneurs to our economy cannot be overemphasized."

-Craig Newmark, Newmark's Door blog
Associate Professor of Economics, North Carolina State University

More praise for *Bootstrapping: Weapon of Mass Reconstruction:*

"Mitra clearly has a passion for small businesses. This useful volume is largely comprised of interviews with the founders of such companies. Her skilled questioning prompts a discussion of the many issues involved in starting and growing a business. The entrepreneurs share wisdom and insight useful to any budding or existing business owner. The reader will be struck by the vision, inventiveness and sheer determination of these entrepreneurial heroes, who operate businesses that are successful but far below the radar. A highly relevant and timely work on entrepreneurship's role in economic reconstruction."

-Kirkus Discoveries

"Sramana's work on bootstrapped entrepreneurs is an inspiration in these tough economic times. The solutions to our economic problems ultimately lie with the entrepreneur who brings imagination, resourcefulness and good old-fashioned elbow grease to tackle old problems in new ways, create new solutions and new industries. It is all too easy to forget this, particularly when we feed on the depressing daily diet of endless bailouts and hear trillions of dollars being thrown around. A great entrepreneur can do a lot with ten thousand dollars. This book is a good antidote to the depressing mood of these times."

-Sridhar Vembu, CEO of AdventNet and Zoho,
Bootstrapped to over $50 million in annual revenue

"In the end, a true entrepreneur will not be denied. What Sramana captures with simple grace are the riveting personal stories of modern day business alchemists, who mix vision, pragmatism and relentless effort to forge creative new and successful ventures. Her collection of interviews will make for an engaging, educational read, for those in the entrepreneurial space, those considering joining the game and those just plain curious about the formative innovators whose efforts provide outsize social returns of the most concrete and enduring nature."

-Don Hutchison, Silicon Valley Angel Investor

Entrepreneur Journeys, Volume Three:
Positioning: How To Test, Validate, And Bring Your Ideas To Market

In *Positioning: How To Test, Validate, And Bring Your Idea To Market*, the third book in her *Entrepreneur Journeys* series, Sramana Mitra offers a close look at the process of sculpting your idea into a sharply defined "go to market" strategy. Clarity, Mitra confirms, is the ultimate tool in building a successful business. But such clarity cannot be purchased or assumed – it requires asking the right questions. Mitra showcases case study after case study of successful entrepreneurs who have answered these questions, analyzed their markets, and defined their value propositions through differentiation, competitive analysis, market sizing, and, among other core elements of a compelling strategic marketing plan, segmentation. The process she takes her readers through is akin to the grilling venture capitalists typically put entrepreneurs through. A grueling test to any business idea, Mitra's book stimulates a due diligence exercise, which no matter if you are bootstrapping or raising venture capital, you must put yourself through to avoid wasting precious years and scarce resources.

Some praise:

"At the beginning of 2009, I found myself without a VP of Marketing in a young start-up company and a new product coming out of the door that would radically change the positioning of the company. I had been introduced to Sramana by a VC who said, 'you have to meet this great lady just to know her.' I contacted her to help me redo the positioning of the company. She did an excellent job in a short period of time using her crisp methodology that has now positioned the company for success. There is no better person to write a book on positioning. In this new series, she lays out the requirements for positioning and uses real world people and companies to illustrate her points. She is a no nonsense leader in our industry that must be listened to."

-Mark B. Hoffman
Chairman and CEO, Enquisite; Founder CEO, Sybase; CEO, CommerceOne

More praise for *Positioning: How To Test, Validate, And Bring Your Ideas To Market*:

"Too many entrepreneurs allow their passion to drive them to take action rather than to distill their wisdom. This leads many to jump right into building out generic business functions and pursuing generic strategies. What I've seen over the years is that the most successful entrepreneurs are the ones that pause to deeply understand what market potential they exactly want to unleash. They then set out and test and evolve. Sramana, in her book *Positioning: How To Test, Validate, And Bring Your Ideas To Market,* provides the critical case studies that highlight how entrepreneurs should continually self-evaluate and refine their ideas. It's a great reference."

-Gus Tai
General Partner, Trinity Ventures

"Many start-up companies dissipate precious energy and capital without ever reaching a point of clear market traction. Too often, their failure stems from their inability to operationalize their vision into a compelling value proposition targeted at clearly defined customer segments. Sramana Mitra's book *Positioning: How To Test, Validate, And Bring Your Idea To Market* combines personalized vignettes of passionate entrepreneurs who, through trial, errors and sheer determination, have managed to integrate this important lesson across the defining dimensions of the emerging Web 3.0 environment. Aspiring entrepreneurs and experienced venture capitalists alike will benefit from this compilation of focused interviews and will want to test their own enterprises against the scrutiny of Sramana's probing questions."

-Eric Benhamou
Chairman 3Com; former CEO, 3Com & Palm; CEO, Benhamou Global Ventures

"Sramana Mitra combines the analytical and questioning skills of a Silicon Valley venture capitalist with cases studies of how successful entrepreneurs used that intense examination to find clarity. The author takes a holistic approach to marketing that examines the path of the product from the idea stage to its final market positioning. Sramana Mitra points out that an idea must be differentiated, and must be able to be targeted with laser accuracy at a specific market segment. Knowing the potential market prior to launch will save both time and money for an entrepreneur. Through the very intensive questioning technique, provided in the book, any idea can be given the same fundamental analysis expected by venture capitalists and other investors. The result is a clarity of vision that will lead to success."

-Wayne Hurlbert, Blog Business World blog

"Another feature that I have found to be especially valuable in this series, is the no-nonsense approach to management that these entrepreneurs, forced to sail so harrowingly close to the wind, are compelled to learn and to apply so effectively in their rapidly growing companies."

-Jim Stroup, Managing Leadership blog

"Before you get too far down the line with your 'next big idea', a reading of *Positioning* might do wonders to help you narrow your focus and improve your chances of success."

-Thomas Duff, Duffbert's Random Musings blog

"I enjoyed *Positioning* as much as her first *Entrepreneur Journeys* despite its being more narrowly focused. It's quite an easy read given that it is essentially a collection of short stories used to illustrate some key insights. For those curious about what makes companies successful, how technology can lead to solutions or perhaps the more specific goal of Mitra - how to 'go to market', *Positioning* delivers."

-Alan Brochstein, SeekingAlpha/AB Analytical Services blog

Vision India 2020

A call to Indian entrepreneurs everywhere, *Vision India 2020* challenges and inspires readers to build the future now. In this "futuristic retrospective," author Sramana Mitra shows how over the next decade, start-up companies in India could be turned into billion-dollar enterprises. Encompassing a wide range of sectors from technology to infrastructure, healthcare to education, environmental issues to entertainment, *Vision India 2020* proves how even the most sizeable problems can be solved by exercising bold, ambitious measures. Mitra conceived *Vision India 2020* from her years of experience as a Silicon Valley strategy consultant and entrepreneur. Well aware of the challenges facing today's aspiring entrepreneurs, she provides strategies, business models, references, and comparables as a guide to help entrepreneurs manifest their own world-changing ideas.

Some praise:

"*Vision India 2020* is a visionary romp through a possible new future for India. It looks back over a decade-long transformation of the country from its current status as 'back office for the world' to that of world leader through the application of the principles of visionary entrepreneurship."

-ForeWord Clarion Reviews

"*Vision India 2020* is a timely addition to the series of recent overtures on how India is emerging as an economic superpower amidst its myriad challenges. Sramana pontificates like a visionary entrepreneur with her bold, sincere and pragmatic diagnostics, and then, comes up with her skillful problem solving techniques. As most parts of the world economy remain eclipsed by the ominous clouds of recession, this book throws up positive insights for truly bold entrepreneurs.

-Arjun Malhotra, Chairman and CEO of Headstrong,
Chairman of TiE Global, co-founder of HCL Technologies:

"As a person whose career ran parallel to the Indian information technology industry for nearly forty years since the beginning, the ideas presented resonate well with me. These ideas were articulated in a simple yet powerful manner that can set a lot of triggers in your mind. I strongly recommend *Vision India 2020* for the senior management of India Inc. and I am sure that it can open up many new avenues for building new businesses."

-Dr. Sridhar Mitta, Managing Director & Founder,
NextWealth Entrepreneurs, Managing Director of e4e India, Trustee of TiE Global

You can learn more about Sramana Mitra at www.sramanamitra.com

1M/1M Online Strategy Roundtables for Entrepreneurs

In addition to her books, Sramana Mitra offers a series of free 1M/1M online strategy roundtables for entrepreneurs to address positioning, financing, and other aspects of a startup venture. Up to 1,000 people can attend each session, but only the first five who register to pitch will be able to present their business ideas. All attendees are able to join in on the conversations via a live chat.

These roundtables are the cornerstone programming of a global initiative called One Million by One Million (1M/1M). Its mission is to help a million entrepreneurs globally to reach $1 million in revenue and beyond, build $1 trillion in sustainable global GDP, and create 10 million jobs. You can find out more about the 1M/1M initiative at:

www.sramanamitra.com/1m1m/

You can find more information about these webinars, recordings of past roundtables and registration links to upcoming sessions at:

www.sramanamitra.com/entrepreneurship-strategy-roundtables/

We hope you will join us!