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Innovation in a Disruptive Environment (Entire Talk)

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Steve Jurvetson, partner at Draper Fisher Jurvetson, offers perspective on the market opportunities in innovation and technology. Topics discussed include the necessity for utter market disruption, interdisciplinary solutions, and advice for those interested in working in the venture capital arena.



Transcript

So, what I've been sort of hoping to talk about with you and share some thoughts is our perspective as a venture capital firm and as a practitioner of that art of what we're seeing in the entrepreneurial community, because frankly the thing I love most about my job is the daily meetings we have with entrepreneurs who are bold and brash and set out to change the world in some meaningful way. Sometimes they do, sometimes they don't, but we get the joy of learning from them. And in some ways my job as a speaker is to integrate the best of what I've learned from them and some of the patterns we're seeing in technology trends and such in the industry. I'll try to just speak for maybe half the time and leave the other half for questions if I can, because inevitably I know you're going to be interested in something that I didn't preanticipate. It is good to be back on campus; I have done three degrees here. And I remember a course very much like this vividly during my undergrad days where they brought in parades of entrepreneurs and folks from the community that really helped connect the Silicon Valley. And it's something I remember vividly as I'm glad to be part of that again today. So, what I want to talk a little bit about is disruptive innovation. This is what startups do. It's different from other kinds of innovation.

Sustaining innovation, if you subscribe to Clayton Christensen's view of life, and technology-accelerating change. In other words, the pace of change that's being induced by technology and why that's particularly important and synergistic with what we do what entrepreneurs do. And then give some examples. I couldn't possibly cover them all. As a venture firm, we've invested in a wide variety of industries and sectors. Some of the ones that interest us the most don't even have categories yet. They don't fit in a bucket. They don't fit in a category. Their unique idea is of one sort of another. But I'll give one example that may be of some interest to anyone interested in information theory or life sciences and that's the integration of the two, the reengineering of the information systems with biology.

It's one of these frontiers of the unknown, one of these exciting areas of future progress that I think warrants a lot of attention; certainly it's getting a lot of it on campus and engineering sectors and one that excites us and myself. So, just one slide on us for background. We're unusual in a couple of ways. We're a very early stage-focused venture fund. Although there are several who do that, but more unusual is this federated network of funds we built around the world, most recently announced today in Russia, and a couple of weeks ago, a big expansion of our European operations. We're trying to build a network of venture funds across the planet that are cross-linked by equity ownership but not managed centrally. And so, we can hopefully benefit from some sort of rolodex of network benefits, partner introductions, resumes, deal flow, information about markets and such yet not try to bog down from one big organization that's managing many offices. So, that's an experiment in process we've been doing for about 15 years in this expansion mode and I think we can scale the venture business in a way that can tap into entrepreneurs around the world, not just in Silicon Valley. I think I heard the audio cut in now. Was that sounding OK for you? OK, enough on us.

Maybe I ought to mention an aggregate we have about \$6 billion on our management but it's only small pockets that are investing in startups. So, there's no one fund that's \$1 billion, for example. So, topics. There are a lot of things, a lot of change in the world. We see it in the news, reflected in market share shifts of companies, shorter life spans of companies, shorter life spans of countries, and initiatives of technologies and products. And there's a lot of reasons for this. One of the fundamental drivers is technology and disruptive technology in general. And it's all very synergistic of what entrepreneurs day in, day out. So, one of the main points I want to try and make today is that this pace of change is only accelerating and that entrepreneurs are the main drivers of it, and that they are fundamentally themselves changing through a sort of a mutually synergistic benefit of both globalization and network effects that feed each other over the Internet. So, why is this important? I'm guessing it's of interest to anyone who sort of is close to technology or technology business in their interests or futures.

But it also impacts the fate of nations. The way Singapore is going versus its neighbor Malaysia can largely be traced to themes as to how one taps into advances in the language of the digital era and now diginomics era. The entire fate of nations in context for our lives is going to change dramatically and has quite a bit so far. For what we do in our business, of course, is very important; that's why we pay attention to it. But I think also, it doesn't matter who you are, it's a fundamental cause of optimism. I think when you dwell on the pace of technology change, it really cheers you up. So, what do VCs look for? Just one quick slide; it's probably obvious but this is the way we like to frame it. Almost every VC will tell you the first point, passionate entrepreneurs; of course, that's what we have to look for. This one is somewhat unique to us. In other words, I don't know if any venture firms emphasize this second bullet point as much as we do.

We really try to find unique ideas, not sure moneymakers, not yet another great idea that fits in a framework of investment thesis that we just roll out over and over again. We really try and make every one of our investments one-of-a-kind. And that gives you a lot of ancillary benefits like diverse syndications and things of that sort. And of course, they have to have both the desire and a plausible plan to change the world. Something bold, something brash, not just arbitrary-seeking opportunists looking to make their quick buck. A lot of these other things you hear about from venture capitals are I think derivative from these core points and much of our strategy and tactics is a firm drive from just one simple rule from Cathy Eisenheart's sense of simple rules from which all strategy derives. But one of the things we really look for is disruptive technology, so let me focus on that. Why is that? So, let me ask a question to you. Why does a startup exist and why do venture firms exist? They are going up against daunting challenges, right? Undercapitalized, no brand, no market presence, no prior customer relationships. A startup company has everything stacked against them, except for one thing.

Usually, there's something related to disruption. If it weren't for this, a startup wouldn't win. If you had stasis, stability, and predictability at any given market, you don't tend to see startups. And so, it's sort of an obvious point. But the one we'd like to focus on: That if you don't have something disrupting the marketplace, it's just going to be the big guys getting bigger, right? Here are some examples of ones that we think of, but most of these we can't really invest in any given sort of ongoing strategy like 10 years from now, 20 years from now. I couldn't count on most of these like structural changes in markets, deregularization, privatization. These are great opportunities when they come in certain economies around the world, but you can't count on the next one 20 years from now. I couldn't predict what it might be. Even financial turmoil itself is a form of disruption. It's kind of funny but some of the companies in our portfolio, they're doing the best around the automotive industry, an industry that's just completely disrupted through the financial turmoil and all kinds of interesting self-induced injuries around pension plans and what-have-you that allows the Teslas in the world or even software companies that sell to auto dealers, are having a booming business, right? And it's usually some form of disruption that allows innovation to come in.

Sometimes disruption can come from new challenge of distribution. If you think of when Dell first entered competing with Compaq back when they were like resellers versus direct-to-consumer kinds of channels that were forming for first-line computers, it was almost as if Compaq's fate was written on the wall. And sure enough, Dell took the business and the franchise away from Compaq in its early days because of their ability to exploit a new channel distribution. And if it weren't for that, just being yet another computer manufacturer didn't make the difference. And all the other competitors of Compaq that were classic in the same business through the same channels didn't really have as good a chance. The Internet is a classic example of new channel distribution, sort of the largest disruption in how you reach customers. By channel, I just mean what is the method by which a company reaches its customers, through what intermediary, through what sales channel. Internet's the biggest change in that that we've seen. I'm not sure what the next one is, it probably something to do with mobility, but I can't predict what the one after that would be. So, again, it's great when you find them but hard to predict a sustainable business, which entrepreneurs be around 50 years from now, will they be around 100 years from now, not sure which of those I can count on.

This one I will count on. Every year, every decade, every century, disruptive technology advances continue and they compound. And they become more and more powerful. So, this is the one that really gets us excited. It may have been in the noise, but it kind of answers the question, "Why are these VC's focused on technology. Why are they doing so few retailer deals or so many other parts of the economy?" Service economy is a bigger part of the economy than the goods or physical products. And why are we in these weird niches and why does it seem so natural for us to do that and so unnatural to invest in

other areas? It's because this is where we find these disruptive dynamos to glom on to. A lot of the advances tend to be interdisciplinary, which is great when you're at school. You can study many things. The thing about integrating innovations from one domain into another, where the sort of stovepipe thinking within businesses, within academic disciplines, tends to isolate the thinking.

If you can be one of those cross-pollinators, usually you can think of a disruption that hadn't been thought of before. Now, I might argue that most of the game-changing advances in science tend to come from that field. Not from the warmth at the center of the herd but from some unusual thinker out of the box. The changes are also nonlinear. It's very hard to make business predictions using straight lines and paper when the curves are exponential. And then, you got maybe fundamental lack of thinking or lack of use of log paper in business to make this such a predictable advance for the new entrant, like Apple entering the music business and taking the Walkman franchise from Sony. I mean, you could have predicted flash memory prices and disk drive prices and seen the point when the tape drive was going to disappear, yet the incumbents just did nothing about it. They somehow couldn't see that change that would inevitably occur in their business as it went digital. So, some examples of exponential curves. It's a historical one, one of my favorites, of course, while going back to the Internet boom, a remarkably smooth curve of growth that the Internet provided.

That was one of the pure examples of network effects, what we came to call viral marketing, where you didn't know traditional marketing if any, but the product propagated over the communication channels of humans and the way that they communicated with each other. In this case, Web-based email for the first time grew very rapidly, acquired a nice outcome for investors. By the way, the product was built by one person in three months, Jack Smith, and caught our attention because these are the kinds of things we love to invest in. So, we found another one but we didn't invest in this one. It came out in Israel, ICQ. What was astounding is that if you compensate for when they launched, which was six months staggered, but if you make the curves sort of the same, they start at the same axis point, it was the exact same pattern of growth. They told two friends and so on and so on, like the old shampoo commercial from I guess it was the '80s; you probably don't remember that. In any case, it was a remarkable, similar pattern that made us think about what are the formulas that are driving biomarketing and spreader products and buddy networks and such. Then, this motley crew came into the picture. Again, speaking of globalization, before I get to this story, let me go back, does anyone know where Hotmail was based, where the company was headquartered? Audience: Fremont? Steve Jurvetson: Oh, man, first right answer! Did you work there or did you hear me say it before? Audience: Yeah, I worked there.

Steve Jurvetson: OK. Usually someone says Bangalore or whatever. They purposely chose Fremont because it's free email. You want to launch a company from Fremont. They were on Liberty Avenue in Fremont. They launched on the Fourth of July and, of course, that was all a big no PR whatsoever because no one was paying attention on the Fourth of July. So, in any case, now Estonia, my homeland so I am biased, but a small group of people there built a product remarkably quickly that set new records for the pace of growth of the new product built, Kazaa, in the music space, because it has been proven to grow quickly. But then, Skype was slightly a more serious product that some of you may have heard a speaker here recently from Skype, it's a remarkable story, over 400 million users and growing quite rapidly and recently spun out of eBay. Or at least in the process of being spun out of eBay. So, what's interesting about Skype is not just their sure growth but the fact that they built a brand in such a short period of time.

There was a question asked in this case in 2005, what product has had the greatest impact on your life in the last year? And it was an open-ended response form; people just filled in their responses. And it's quite remarkable coming in out of nowhere is the third product behind Google and Apple, again, with almost no marketing budget whatsoever, that really caught our attention. It said something is new about the network economy. There's something new about globalization and the interplay of both. These startups can come from anywhere and they can serve global customers they want in ways that we just couldn't do 10 or 20 years ago. When I started in the business, we invested in US companies, primarily California, serving US customers. And we didn't worry about international customers until we started to get ready to go public. Around the time you're filing your S1, you'd set up a joint venture in Japan and maybe one in Europe. But as a venture capitalist, that wasn't your forte. It wasn't something you expected to be able to help companies with, but now that has completely changed.

Changing it even more is one of my favorite people, Gordon Moore, at least the eponymous law that is ascribed to him. He likes to go salmon fishing in Half Moon Bay. So, here's a photo I took of him. In fact, I think all the photos in here are ones I've taken. Just an aside, I love photography as a hobby. And he's a wonderful guy and he came up with something called Moore's Law. Now, I want to ask how many people have seen Ray Kurzweil's version of Moore's Law, which is an abstraction of Moore's Law that goes back over 100 years? Come on! Only two hands? Three? Wow, it's actually one of the lowest response rates of any audience I've seen. I don't understand what that means. Usually our investors like our OPs, they don't read this kind of stuff but anyway. I think it's the most important graph of all technology business in all of history of technology business.

And what it's showing is to explain in a logarithmic scale. So, a straight line on this would be the exponential pace of growth that is slightly upticking that Kurzweil argues is a double exponential. We're looking not at how many transistors are on a chip

but how many calculations per second you can buy for \$1000 because nobody buys transistors, right? Intel may care about transistor count. Moore is the co-founder of Intel, he certainly cared about it. But people buy computation and storage. In either way you graph it, you get this remarkable curve that transcends any one technology. So, these sort of colored bands are integrated circuits, discrete components, vacuum tubes, relays, mechanical devices. The dots are the sort of price performance leaders of their day. So, there may be other companies that fill or products that fill the graph below it. These are the frontier of human computational capacity.

It says a lot of interesting things. First, what does that mean? There are deep cosmological questions and all kinds of evolutionary arguments one can make about how we use our technology, develop our tools and so and so forth and where might this head, by the way, if it goes from just another 25 or 50 years and \$1000 buys you more computational power than all human brains on earth combined. You'll reach some kind of staggering points if this continues. It also begs the question of what the next technology platform would be, molecular electronics or nanotech or spintronics. Computing beyond the integrated circuit doesn't have to be CMOS silicon, as we've known it. Something new may take over. But most importantly of all, at least from the source of optimism and interest, is that there seems to be absolutely no coupling to the economy. So, these companies may have come and gone. But the Great Depression, all the recessions, World War I, World War II, have had no meaningful impact on the trajectory progress of innovation technology, which is really astounding. You just really stop and let those sink in because in the middle of this economic recession, you might think, "Oh, innovation dries up," and it doesn't.

Within university labs, it's just booming like crazy. The companies that take advantage of that may have pent-up demand and maybe more pent-up disruption to take advantage of when you finally do come out with a new product or service. But the pace of human innovation, I believe, continues unabated and is exogenous to the economy. Pretty cool. Now, what are some reasons why people seem to have a hard time taking this as a sort of business planning? Well, here's one graph, this is historical on purpose, during the Internet boom time, where if you just took, in this case a number of Internet hosts or Web servers out there on a Web rhythmic scale, you'd see this particularly uninteresting curve, the way scientists would plot it. If you take the exact same set of data points but plot it the way newspapers would report it, it looks like that. And so, the way they tell the story is, "I don't know where the Internet exploded on the scene here." Why? Let's look back to what was going on here. Netscape's IPO, that must have been what it was around this time frame, or when you add a few more data points and shift the knee of the curve because there's no knee in the curve when it's plotted on this kind of paper. The knee of the curve is just an illusion based on some random choice of axes when you plot it this way. Time passes and all of a sudden, it's Google saying, "Well, as you know, it's us that made the difference in the pace of growth." And it's always history is told by those who are a couple of years after the inflection point of the random curve you happen to draw at that time.

They're never the first mover. There's no such thing as the first mover advantage in technology. It's just whoever wins says they were first to redefine the market and such. And Steve Jobs was a classic at that. Great stories in Q&A if you want. OK, for those of you who aren't interested in IT, realize that all these accelerating curves of change or not need be special to IT. So, sure, they occur in all these areas quite dramatically. But they also occurred in the life sciences in ways that are less well appreciated and not fully understood. Dickerson, not well known but he actually was more accurate in his prediction in 1965 about something fairly mundane about the number of proteins that are in a crystalline structure, which will be determined over time. And he has been accurate to I think less than 0.5% to the current day, which is quite remarkable.

Now, what's an example that's maybe topical and relates to the information knowledge or embedded content of the entire sort of life sciences and genomics revolution. It could be the number of genes that are sequenced. It's just one process that just happens to be the one we have the most data on so it's nice to plot it. Here's what it looked like leading up to the sequencing of the human genome led by Craig Venter and then a competitive government effort as well. And you might say, "Well, wouldn't that be the pinnacle of accomplishment, wouldn't we just kick back the next 10 years and digest all that information that came out of the human genome project?" And by the way, a lot of the stories were told about how 98% of the project was completed in the last year, which is exactly what you'd expect in these kinds of curves. So, you might say, "So, where does it go next?" Well, it's interesting; here's just five more years of data so that last curve ends here and it just keeps going. What are these people doing? What are they sequencing? What is all these data that's being dumped into the public archives? And would it continue? I mean, taking this current data, would it just go off the chart? And sure enough, Craig Venter has grown this data set tenfold in the last two years. How do you do that? Well, he realized there's microbes everywhere; it's not a big insight. And there's going to be a segue into some of the industrial biotech 2.0 stuff that we're investing in and excited about. There's a lot of microbes out there, a ton of it in the seawater.

Every time you get a little gulp of seawater, you're swallowing every milliliter millions of bacteria and viruses. And they're incredibly diverse. And there's a lot of them out there. And oh, by the way, they make up the majority of the earth's biomass. In fact, most of the cells in your body are bacterial. If you look at the unique DNA, 99% of the unique DNA in your body is bacterial. So, 90% of the cells, 99% of the DNA. You're kind of, as I call it, a big bag of microbes. So, what are these things? By the way, you can't digest certain metabolites in your bloodstream. They only come through bacterial channels.

The human body is unable to produce some yet they're throughout our body. There's all kinds of synergies, we just barely understand how microbes give us life. So, what Venter did was he did the best boondoggle ever, financed by Gordon Moore and the Department of Energy, went on a sailboat around the world, Polynesia, Fiji, and all his current destinations, and sampled seawater about every 200 miles and ran it through his gene sequencing techniques. He had the insight that he thinks computational power, again, Moore's Law had reached the point, threshold where we don't even have to distinguish the organisms in an ecosystem, just run the entire ecosystem through the shotgun sequencing methodology where you blast the DNA through random fragments, have the computers try to put it all back together again. That was his insight that let him win the human genome sequencing project. People said it couldn't be done. Computers caught up, the prediction of Moore's Law hit right at the right time. And boom, they could synthesize the genome on a human project. So, similarly with the ecosystem, just put the whole ecosystem through. Don't even care where the organisms came from or which one came from one or another and figure out what are all the genes that exist out there.

And this is how he has grown by about a hundredfold the number of known genes involved in energy transduction, so taking energy from the sun and harvesting it for various uses within the cell. These organisms in the ocean had evolved over longer periods of time than land-based plants and animals. And they are much more efficient than the photosynthesis that we know of on land. Certainly, he found immense biodiversity. For the ecologists in the room, he found that sometimes in the open ocean between successive samples, the biodiversity was 85% different. It'll be like tundra and arctic and rainforest in terms of biodiversity in the microbial populations. Now, why would you do this? Well, it turns out the pace of progress and synthesizing genes is growing faster than the pace of reading them. So, this is again totally different and incomparable scales than just the slopes you can compare. Moore's Law is growing roughly the same as gene sequencing or gene reading. But gene writing is growing at a much higher slope.

The insight, the ah-ha that Venter had was, "I don't really need to have to sort organisms anymore." One of the fundamental insights was up until now in biotech, he had to cut and paste from living organisms, right? He had to take DNA from something you could find and insert it into something else if you want to make more of it, but you had to find the host organism from which it came. Today, you just send a file to about 20 different places around the world. You email the file; they FedEx you the DNA. No animals are involved; just give me ATGCC. It's just code. One of the first things synthesizes polio a few years back, part of a stunt. Viruses are small. It caught people's attention. They made polio from scratch in a lab and none of the people contributing the DNA even know it was being done, which was a little bit of a problem. Bacteria's much larger.

Venter has done that this year and is about to boot up the first synthetic organism or the first artificial life form where the DNA did not come from any animal. He has shown that you can take 100% of the DNA out of one organism, put it into another and change that animal, sort of alchemy, if you will. And the genetic codes are as different as mice and man. Now, these are microbes, single-cell organisms. But nevertheless, a whole cell change of phenotype from swapping up 100% of the DNA has been shown. So, the idea is that you'll usher in a new era of synthetic biology. A wonderful professor who recently joined Stanford, ground floor of the Y2E2 Building, Drew Endy, before that was involved with starting Biogen International Genetic Engineering Machines Competition, where children, teenagers, (you can call them children), teenagers basically compete globally to build microbes that are doing things, flashing units. The first thing they did is make them smell better, because E. coli smells like the place from which it comes. And so, he made it smell like bananas.

That was the first step. Others use it, too, as an arsenic detector. The winning teams are from a competing university in Slovenia this year. And one of them is pretty cool. They created a biofilm that reacted to light and then it sort of changed color. So, it was literally a photographic plate with resolution greater than that of normal film and you could expose it and get an image. So, it's like an "Ecoliroid", if you would call it that. So, if you don't know Drew, get to know him; he's great, ground floor of Y2E2. So, what is this new era, this new sort of example of groundbreaking change? If you're not in this domain and you get exposed to it the first time, it usually makes your jaw drop, especially with computer scientists. In a sense, they're treating life as software and building organisms from scratch and application cassettes that they would insert into the esthetic cells, esthetic chromosomes, and the coding is as software builds on hardware because it's living producing organisms.

You can then also use directed evolution or basically evolution at a lab where you select the fastest growers by some criteria and do, in a sense, artificial evolution. You make a big advantage geometrically from much bigger advantages through artificial evolution than purposeful design. That's kind of poignant. And the applications, of course, are in some pretty big markets that are in dire need of change to get off the petrochemical economy. So, let me give you concrete examples of how that business might work. First as an abstract level, what would you do? You'd make the cells that make products from waste feedstocks or directly from CO2 in some of the most interesting cases. By the way, it's catching the attention of a lot of people. I grabbed this frame grab from a video this morning. So, Obama just gave the National Medal of Science to Craig Venter earlier today. And about a couple of months ago, Exxon Mobile did a \$600-million, well, between \$300 and \$600, depending on how you do your math investments; so, \$300 of other investment and co-investment into algae-based fuels.

And what they're doing is producing fuels that can run in your cars and jets directly from CO2 and water and sunlight and

they're getting them to excrete directly across the cell membranes. You don't have to kill and harvest in batch mode the algae but you just continually secrete across the cell membrane, which is an important advance on the separation costs of all that. And what are the other things you can do with these microbes? Well, it turns out they naturally love to chew up coal; at least there are groups of them that do. It naturally occurs; about 10% of natural gas comes from the source where deep underground microbes, anaerobic microbes, are chewing up coals, dripping electrons and producing methane. So, you can convert the dirtiest, most expensive to extract of the fossil fuels into the cleanest burning, easiest to extract. So, almost no noxious byproducts. So, what I want to do is understand how do these microbes work, how can we enhance it, how can we have coal and natural gas without ever digging up coal in the first place. For example, they went down in the San Juan base and they drilled down into a pocket of water that was sitting under there. And it had been detached from the rest of the world for over 70, now estimates are about 100 million years, according to the carbon dating. And there was an entire ecosystem organisms living off each other, no sunlight, no exposure to air whatsoever, almost like a genetic time capsule from the past and remarkably efficient at what they do.

So, the business opportunity there is to understand what they eat, what catalysts might improve their performance, what consortia of these naturally occurring organisms, not genetically modified. Because this could be a Kurt Vonnegut and Ice Nine scenario if you made it too efficient. That's one for the science fiction buffs. But you basically want to think about how you could enhance the way biology is doing what it already does naturally around the world. So, what's another example? How can we get rid of the multibillion-dollar fingers that hang off the petrochemical industry? It's depressing that 90% of all our organic chemicals: your Pampers, your toothbrushes, your plastics, they all, of course, come from oil. And right now, they go through crackers, both catalytic and heat-generated, across of these. And ideally we'd like to swap it for something we will use like sugar, waste, CO₂, things of that sort and turn it into fuels and heavy plastics. So, let's give you one example of that. It has been worked on this year and quite a bit of progress is made by a little company called Genomatica. It's in a niche called butanediol, again, a multibillion-dollar market, one of many.

So, it's just one little specialty niche of the petrochemical industry. It's used to make spandex. So, for those of you worrying about the future of spandex, it soon will be green as well as a bunch of car body parts. But here's what's really cool about it. No organism on the planet makes butanediol, right? So, there's no plant or animal that makes it. And so, what the company did is they used a computational screening model to explore all possible pathways that could get you from sugar to that. And they explored 40,000 different pathways and figured out optimally carbon utilization. What do we think is going to be the best way to get the products we want from sugar? Then, they engineered, purposeful design, if you will, a way to get from A to B through a series of intermediate steps, all within a single organism and within its metabolic process. But then, they did something very clever. They crippled the organisms redundant pathways of survival.

So, the only way this organism can live and reproduce and have a nice long life and produce children, it makes more of the chemical you want as a byproduct. So, all the other redundant pathways are knocked out with a bunch of gene knockouts, so that in its own ATP cycle of how it lives and how it harvests energy, it will make more of the chemical you want. The reason you do this is that rather than having the organism evolve away from what you want, you then just screen the fastest growers, picking up whoever is growing fast and put them in a new bath, pick off the fastest growers, put them in a new vessel and so on. And you get an improvement way beyond human design. So, they got about a twenty fold improvement of just using human smarts to go from the initial organism that did an OK job when they inserted the gene pathways to maybe a twenty fold improvement. And then, last year they had a twenty thousand fold improvement through artificial evolution, just saying, "We don't know how it's doing it but we just keep skimming the fastest growers and making more and more and more of the chemical we want." So, it reminds me of something I read in a software book, the closing chapter of Danny Hillis' book "The Pattern on the Stone", "The greatest achievement of our technology may be the creation of tools that allows us to go beyond engineering, that allows us to create more than we can understand." And I think that's pretty profound. He was thinking of the software context, which I think an artificial intelligence, neural networks, and a variety of other areas. That's absolutely the future of, I think all these systems we built. And I think it's the future of complex systems development in general that the design-engineered purposeful approach is going to cede way to more of an out-of-control biologic process in both the literal sense and in the metaphorical sense in how we build systems of software. So, what might that mean in sort of driving towards some sort of closure on this point? An interesting intersection where what were formerly discrete demands of information science and life sciences are cross-pollinating in very interesting ways.

Both the tools from one are being used in the other, the lessons learned in one are cross-pollinating to the other. How can we build a better neural network model? We're looking, of course, to better models in the brain itself. So, each of these fields is driving each other in learning during cycles. It's quite remarkable. And it's applied in all kinds of random places you wouldn't imagine, like using a molecule similar to chlorophyll to make organic memory chips that can compete with flash memory one day and are incredibly small; much, much smaller than anything we built today and use a sort of splash-and-rinse manufacturing step instead of high-energy physics process in the current fads today. And so, there's some pretty interesting cross-pollinations and breeding of these ideas across formerly discrete domains. So, now I showed Ray Kurzweil's version of Moore's Law and a couple of other of his accelerating curve charts. And if anyone reads one of his books, you'll see page after

page after page of these accelerating changes going on in technology. He had an interesting summary takeaway that you can sort of easily remember, and this is true in perpetuity, meaning it will be true 20 years from now as it is today. Then, if you look forward 20 years to the future, you'll see as much technology advancement as the past 100.

And that's pretty profound. If you think back to like 1909, anyone remember that? I don't. But in America, if you were born in the early 1900s you were born at home without electricity, not in a hospital. You probably didn't graduate high school. Society has changed dramatically in the last 100 years, largely driven by technology and vector ongoing education and social equity. And to think that not as much changed. I mean, human nature is glacial and doesn't change from year to year. But the drivers of comparable change, think about all the genomics revolutions; think about what has happened in the last 100 years with birth control and in the next 100 years in genetically modified organisms. It's going to be pretty, how shall I put it, a tension will rise between human nature and the pace of change. But I think some of the near-term implications are the forecast horizons are shorter and shorter, predicting next quarter is going to be as difficult as predicting next year.

An idea of a 100-year business plan is absurd as it ever was and soon it will be the one-year business plan will get absurd. And you have perpetual future shock. But I used to think, "It's that young generation that's using computers or whatever," and that's because the pace of change was going through a sort of generational 20-year gap. Soon it will be, "You were in the class in '90?" Everything has changed, right? And certain scientific disciplines certainly feel that way. That idea that the future keeps changing faster than we keep with it I think will only accelerate. And that relates to things like Black Swan events. It's a great book by Nicholas Taleb out of Lebanon. I highly recommend it. And he comes at it more from an econometric point of view or economist point of view that says the future is increasingly driven by unpredicted events, things that in retrospect made sense but at the time no one predicted it. And as a venture firm, we try to take advantage of that.

We try to invest in things that most people think are crazy ideas; it's an interesting statement. We don't strive for consensus when we invest in deals. We allow a passionate minority to outweigh a blah majority, right? So, a couple of people that really want to do a deal can outvote like five that don't. The reason is because no good idea that changes the world is universally regarded as one at its outset. So, Google, Hotmail, Skype, the list goes on, eBay. We're generally laughed at by most venture capitalists when they're trying to raise their first round of capital. They were ridiculed; I know they would. Now, you won't get that opinion today. In retrospect, we all change our story. "Yeah, I really tried to get that deal.

I almost got that deal. I would've been in that deal. It was brilliant. I was all over it, but at the time they laughed at it." So, the companies that really do change the world, this may be a source of encouragement for the entrepreneurs with an idea. If everyone thinks your idea is good, it's probably not a big idea. If most people think your idea is bad, that's great as long as you find somebody who thinks it's a good idea. If 100% of the people that you've sampled widely think it's a bad idea, it probably is a bad idea. I don't know that one to be sure but it might be safe. But if you've got a 1:10 ratio, one person likes it, 10 hate it, that's perfect, as long as you respect that one person. I mean, if it's just the village idiot, "I like everything." OK.

So, I don't want to spend time on this, but there are all kinds of weird things. I mean, if you might think computing is done and hardware is on its trajectory, there are some weird experiments going on in the periphery of science with quantum computers that could change everything, where they literally engage parallel universes to computing the way that is unlike any computing done today and could scale in ways that are unfathomable. Some of the physicists out of Oxford and elsewhere have predicted that on a curve that this company D-Wave is on, there's arguments as to whether they're really quantum computers, let's put some caveat there. But if the quantum computers progress on a curve like some people are forecasting they might, they will soon have computers in the next 10 or 15 years that exceed the computational power of all classical computers ever built and that could ever be built if all the matter of the universe was converted into classical computers. That's mind-bending; I'll just leave it at that. So, two more points before leaving on a completely different topic, but I just want to throw it out there in case in the Q&A someone wants to talk about the investment business instead of the entrepreneurial business. We've noticed this pattern now and it's not very well vetted. So, if someone in the audience can shoot holes in this, I'd be very interested. But a weird pattern in venture capital and private equity, meaning things about buyouts and mergers and these people that write really big checks, and then venture capitalists starting new business punctuated by recessions that all seem to have this 7- to 10-year cycles. And the only reason we like it is it would have predictive histories and guides that we're now in a venture capital upswing so it's a good fundraising slide.

But other than that, I'm not really sure why it's due other than long waves and feedback loops that any dynamic system with a long path to feedback tends to oscillate. So the Devan-Cassidy planning all these things can oscillate over the cycle time of feedback loops. And the feedback loops of venture capital and private equity are really slow. And so, a 7- to 10-year cycle makes some sense as to when the inflows and outflows and capitals occur in our business. But maybe we're on an uptake. What would it be? Well, here the minicomputer, personal computer, Internet, maybe energy and clean tech. A lot of great companies are founded in down markets, great recessions, depressions, a lot of great brands. People starting companies during this time period tend to be passionate about what they're doing. They tend to focus on customers more than investors, like Hewlett-Packard, folks in the Disney are the early customer. And they tend to build cultures that scale in a glass.

They aren't just out, again, on a money or land grab mentality. They're really building businesses the way you'd want to see them build. So, we've generally found that some of the best companies, some of the long-lasting companies like Microsoft and Hewlett-Packard and such were started in down markets. So, what might be one of those upticks that we look for? I'm not going to spend time on this slide; I'll leave it for Q&A if anyone's interested. But it may be obvious to all that there's a lot of excitement on energy and clean tech, not just because of public perception, geopolitical forces and market sizes and trillion-dollar opportunities instead of billion, which is what we usually look for. You have a lot of tech innovation, nanotech, biotech, infratech, all feeding into it. And most importantly, people like it. You're cool again with your kids if you're working in this field. So, management flocks to it. Students flock to it all over the place.

You feel good about what you do at work. And some of the best human talent and innovative ideas come from that human talent influx. And so, if for no other reason than marketing, you're going to see a lot of advances in energy and clean tech. And we've been investing quite a bit in it: About 40 investments here out of this office and 73 across the network. We started in energy generation sort of in time; I'm also thinking about its sequence, the smart grid. Storage is really important right now, a lot of efficiency. We're investing more and more on that end, unusual things like agriculture where you can double up the DNA in a plant so you're having four parents instead of two in a polyploid organism. You'll get sort of the uberversions of the plant. It grows bigger, faster, stronger, and more disease-resistant. Less recessive genes are expressed.

So, that's kind of a fun one. A whole bunch of synthetic biology companies and water purification is an area that we're really excited about. So, any of you that have breakthroughs in water purification maybe coming out of the left field, like I got to imagine something going on in regenerative medicine building, artificial kidneys and then membranes for an artificial kidney for dialysis would one day perhaps create a sustainable, maybe solar-driven adaptive membrane for water purification, something different than reverse osmosis, forward osmosis, distillation, the usual techniques. OK, second to the last slide. Basically, what have I tried to convey? We're seeing more innovation than ever before. It's globalizing and it's great. The entrepreneurs are everywhere, opening up human talent pool, removing a lot of the friction and barriers to good ideas serving markets. And those customers, the flip side, are also everywhere. So, you can tap into much bigger opportunities sooner as a startup. And these network effects are mutually enforced by the Internet.

So, we think that all that rolls into an incredible renaissance of learning. So, if you're a student of these subjects, it's really an exciting time to be in the lab, especially in the synthetic biology area or the industrial biotech 2.0 area. And that this perpetual driver disruption technology in one way or another is a great cycle for entrepreneurs because when you think about starting companies, ask yourself, "Why is it now that this business can exist and couldn't have existed 10 years ago?" If there's not a good answer, it's probably not a great company to start. And is there something about technology trends that makes it better and better as time goes on? And we think the bottom line is it's a great time to build new companies. So, with that let me switch to Q&A if I may. And I'm happy to talk about anything I spoke about here or anything completely unrelated. Tom Byers: Steve? Steve Jurvetson: Yes? Tom Byers: We're going to allow the course to do the first question and then open up to general Q&A is that all right? Steve Jurvetson: Sorry. Yes, of course. Tom Byers: Just one second.

Tom Haymore: Hello, my name is Tom Haymore. I'm subbing in for Steve Blank. I'm not sure this is actually working. Does anyone hear me? All right. So, I'm subbing in for Steve Blank on the MS&E278 course, which wraps around this and we discuss the companies and the people that come. And we actually have the great pleasure of having Steve join us for a few minutes after this lecture. Because if you're thinking about the class in the winter, I wanted to jump in here with an entrepreneurship-focused question and ask, "What do you see as the most common mistakes that entrepreneurs make?" We saw some of what you think the great characteristics are. What do you see as some of the common failures, the common critical mistakes? Steve Jurvetson: There's a lot of different mistakes, let me think what's common. I'm trying to think of do I want to filter for the common mistakes we see in our portfolio that has already passed through a filter of we decided to invest in it. And so, there's a sample selection biased to that.

Do we induce the problems or do we have a weird filter in what we look for? Let me start in a roundabout way and see if I can get to an answer if I start percolating on something. The first thing that jumped to mind had to do with people. Because there's a huge diversity in markets. And I'm not sure if there's a generalizable lesson across all industries as to here's how you want to think about your business. But when it comes to human dynamics, they tend to be the same across all companies. And oftentimes, there can be a sort of a control problem with the founding DNA of a firm. So, I've noticed that a lot of great firms tend to have a pair of founders as a minimally sufficient set, the Jobs and the Wozniaks, the Sebeer and Jack at Hotmail. There's a dynamic duo almost everywhere. And even some of the companies that have a very strong cult to personality like Larry Ellison and there was Bob Minor behind him and Paul Allen to Bill Gates. and I wonder if there's something about the best firms and having a marketing skill set and an engineering skill set, not having a single person that shares both of those in the extreme.

And that if there's sort of a mutual respect in the founding team that says, "You do what you do well and I do what I do well." And from the very beginning, we've bifurcated responsibilities and roles and that tends to scale better versus the cult of

the CEO that says, "I'm in charge. This is my company, and everyone I hire works for me and I know how everything works." That doesn't scale as well. And so, one of the classic scaling mistakes occurs when a company reaches the point where it has more employees than the average tribe. You don't know the name of everyone you knew from everywhere anymore. And then, all kinds of managerial headaches ensue. So, coming back to the founding in the early days, it's an old adage that, A managers hire A+ teams and, B, managers hire a C team. It has probably been a euphemism you've heard before. But it's really true that if you don't have enough self-confidence to be humble and you're too much of an egotist, you're going to feel threatened by people who challenge your authority. And you won't necessarily hire the best and the brightest in what they do and the whole thing sort of doesn't work as well. So, we try to find entrepreneurs who have that humility to expose their concerns and say, "Here's where we think we had it nailed, but here's where we really don't know if the answers for real." There's all kinds of other mistakes.

In shifting market trends, the classic example, of course, is just, "Can you forecast well enough and see the pattern on the wall of when you need to downshift or upshift your business growth?" There are a lot of businesses that have stumbled unnecessarily because they sort of didn't have the gyro of their business set right to the pace of customer action. The other, I guess, related point that I alluded to in down markets is that it's really important not to mistake customers from investors or vice versa and think your investor is your customer. If you can, especially in down markets, find a customer to finance your growth, it's going to be a much healthier way to grow your business than continually going back to outside sources of capital. Some businesses need it more than others. But in the energy and clean tech space, there are some that are really capital-intensive on the front end long before they have any feedback from the market. So, we love to see these fast feedback cycles, product release cycles, software as a service, that was one of the big advantages of it, and in a lot of other areas, if you don't sort of have to build it and then hope it's successful, it's going to be a much better way to build a business. And so, to an extent you can architect for pivot, when do you actually start to interface some customers? It's one of the reasons games is such a bad business to invest. You don't know if it's good until they've really polished the product to know if the game play is compelling. A mock-up usually doesn't do the trick. So, there are certain sections we don't invest in because of that feedback cycle.

If you want, maybe I'll come back to it if I can think of a better answer later. Sure, OK. Audience: What was your favorite class in Stanford? Steve Jurvetson: What was my favorite class in Stanford? The one that jumps to mind is Touchy-Feely, as it's affectionately called at the business school, where you do psychotherapy, group therapy basically masquerading as a class. And as an engineer, that was the most sort of enlightening of how detached I was from my emotions and how other people who had different thinking styles weren't really freaks but just really had different thinking styles. And that was eye-opening for me, having gone through much in my life with different set of views. I'm saying that somewhat jokingly but I honestly did think that the pessimists are the bizarre life form. Why would you ever work with a pessimist? Things like that. When I was an undergrad, I really liked all the classes I took outside my major. So, I remember a Professor Romalhart's class on neural networks in the psychology department. And I tried whatever I could do to get as many classes outside my major, which was electrical engineering, as I could.

And those are the ones that I remember much, much more. The only things I really remember from the EE classes were some of the professors and students I met and some of the projects but not like, "Yeah, EE 102, yeah." That was a great one. That help? Audience: Yeah. Steve Jurvetson: Cool. Yeah? Audience: What made you decide to stop being an engineer and become a venture capitalist? Was it more fun? Steve Jurvetson: Well, yeah, for certain personality types, like for the short attention span crowd and the ADD folks. Oh, sorry. When did I decide to shift from engineering to venture capitalism and was it more fun? Was that the reason? So, the trajectory of my career was somewhat of a random walk of sort of successive exposures. So, when I was a EE, I was working at Hewlett-Packard in the seed program doing work, study, work, study. I went over a long period of summers doing chip design at Hewlett-Packard and thought I wanted to be an engineering manager because it was in that framework, in that cocoon of sort of promote from within and lifetime employment, which was espoused at the time. It was a long 20-year cycle to become an engineering manager.

It seemed like they had a lot more influence on the world than the engineers whose products might be canceled at any given moment. I was very naive. I knew nothing about business. And I thought, "Well, how can I accelerate that 20-year path?" I got to somehow find a way to get to business school. That was the only sort of career planning that I had in my life. How could I get to business school because that could be a segue somehow to being an engineering manager. And so, when I was leaving, I was starting a PhD program here in double-E but didn't complete it; I was two-quarters into it. I shifted gears entirely and went to a management consulting firm, Bain & Company. It's a firm that my dad had exposure to. And I never knew anything about consulting firms.

And they must have thought I was remarkably naive and charming when I interviewed. And I didn't even know who the biggest company and the firm was Mackenzie in the industry. I had never thought of even applying there. And I only applied to Bain because that's the only one I knew of. And so, I worked there for 3-1/2 years. But that worked out in a really interesting and fortuitous way. I was working across a variety of different high-tech clients. I expressed the desire to only work on high-tech companies. And I saw all kinds of patterns, almost like case studies, as we do in business school. Vignettes of, let's say, a

merging acquisition situation or a new product introduction or a company going under, or you name it, usually brought in by the CEO as a special ops team to sort of work on some crisis de jour or opportunity de jour.

The one thing that worked according to plan is that did get me into business school. So, that went according to plan. But then, it was a random walk. I thought in business school by that point, I said, "Maybe product marketing will be what I want to do?" I started to get the sense I didn't really want to go back to engineering in quite the same way. And so, I worked in my summer jobs at business school at Apple and Next. I wanted to see Steve Jobs in action. He's a childhood hero of mine, and that was a trip. And I wasn't really sure that was for me, either; I wasn't entirely sure. There was a big economic incentive to go back to Bain because they wanted to pay for the business school. In fact, they did and I owed them all the money back if I didn't go back to Bain.

That was sort of the default. And I was cruising into my second year business school, and then I got a call out of nowhere from a venture capitalist in Greylock, a friend, a former Bain colleague of mine who said, "Come up to the West Coast and interview. Would you like to interview?" I was like, "OK." And then, I did just dive. I spoke to every student; they were the most helpful, and professors, they were also quite helpful, that knew anything about venture capital. This is before the Internet really percolated through any of those industries. There was no way to really learn about what the venture industry was and the difference between the firms. But I just did a deep dive of interviews. And they were informational to start because I just kept getting turned down, again, because I didn't know what I was doing. And to make a long story short, I finally found a group who was called Draper Associates at the time that was very unlike the others. It was much more of a playful camaraderie, tracing it to the founder's personality, a very different feel from the white shoe conservative model that I'd seen in so many other places.

And so, I did join there. At the time before I joined, I thought, OK, I love technology. From the consulting gig, I like diversity more than depth. I like to learn throughout my life. And somehow my brain just clicked some more on learning horizontally than being a master of something in great detail. And so, that has played out that were even more finely cut in a way than at the consulting firms in terms of time slices of attention on what we focus on. But we can stay on the frontiers of the unknown. And with the entrepreneurs we invest in, try to find those ideas that really a cutting edge. That was I supposed to be doing. And so, that's fine because I guess it just really makes it fascinating.

And I don't think of myself as a banker. When I was in business school, I don't think I took any accounting or economics or finance classes. That whole thing bores me to tears. I don't use Excel at work. I mean, I love Excel. I do my expense reports, my taxes on Excel. So, I use it but I have no use for it at work. So, it just gives a sense of a very different kind of work than banking or other types of finance, making intuitive judgments on markets and people. Cool, is that good? OK? Sir? I saw a hand. Yeah? Audience: What kind of profile do you look for when hiring a venture associate? Steve Jurvetson: Into our firm? Audience: Yeah.

Steve Jurvetson: So, the question was, "What do we look for, profile-wise, when we're hiring someone at our firm?" Let's see. I'll give you a specific answer for the firm, but then I'll also try to generalize a bit to firms because there's a lot of good venture firms and they vary. We look for smart, flexible, wholly minded, people that are different from others we've hired. We try to diversify our skill sets and backgrounds. We look for people who have a deep rolodex of contacts and such. But we also look for that self-confidence-to-be-humble point I was making with regard to entrepreneurs. We do look for that in the people we hire as well because even though there can be a lot of big egos floating around in this industry, it could be a barrier to learning, I think, if you think you have the answers. You come in with a game plan as opposed to a spirit of lifelong learning, frankly. So I want to give a caveat and this capital plight of all firms, including ourselves. Whenever we ask that question of anyone in the venture business but maybe in any business notoriously, you'll hear an answer that sounds remarkably like the person speaking.

And the people who don't really have good self-awareness will say, "And that's what you have to have and that's the only way to be a successful venture capitalist." So, I can't tell you how many times when I was interviewing, getting into this field, I hear this definitive statements like, "If you haven't been an entrepreneur, how could you be a VC?" or "If you haven't had 10 years of operating experience, how could you be a VC?" and other contradictory statements made by partners in the same firm, which was remarkable. And then, I might point out on my cover letter, "Well, notice that the people who are like the most senior partners at Excel and Benchmark and Oak, and I'd have this list, haven't had more than a summer job of operating experience in their life. How do you factor that in?" There was no answer, and I never had a callback from any of those firms. So, the only traction I got were people who were themselves consultants, because that was my biggest member of consulting in business school in VC. That was the thing on the top of my resume stack. Those were the only people who were paying attention to me. It was awfully biased I recall. and recruiting is very strong amongst firms that have no processes, no HR department, and managerially they were a mess like every venture firm. So, therefore, your best bet is find someone like yourself on the Web that you can send a letter into. But there is variety, people that have come from their recruiting backgrounds, legal backgrounds, although they cost almost \$1 million.

They're all over the map, engineers, marketers. There tends to be a ton that have come from Stanford and Harvard business schools. So, there is an overt, I think, bias. I don't know that it's so much the simplicity of saying, "We'll be hiring from

it." It's just there's no HR department or process. So, imagine a firm saying, "Hey, send resumes." It'd be overwhelming who's going to read the resumes. So, what do venture firms do? Tell everybody you're not hiring. And then, when you do want to hire someone, they said, "Do you know anyone?" and literally hire someone that's a friend of somebody who's already at the firm. So, like almost everyone in our firm pivoted off of somebody else that we knew, right? And that was one of the few exceptions. My resume was over the transom and the only other exception was Jennifer Fonstad, who came to this program called the Kaufmann Program, which is a great way to get into. And they purposely focused on breaking down this hiring bias, where if you only hire from your friends, those networks tend to be pretty insular.

How can we get more diversity in the venture business? And looking back, we believe as a firm that's essential. You want to get the wisdom of crowds and not have the group think and the partnership dynamic. You want as much diversity in the ideas coming in as possible. And so, we try to do that but it's hard when you don't have an HR department. Cool. In the back row? Audience: How would you compare your role as a venture capitalist to that of a serial entrepreneur? So, someone who's started a bunch of companies... Steve Jurvetson: Yeah, what do you mean by how would I compare it? Audience: How involved do you feel as a venture capitalist you are in the companies that you help built rather than the entrepreneur with the idea in building a team? Steve Jurvetson; The question is, "How would I compare or contrast the venture job to a serial entrepreneur in the degree of involvement in particular?" OK, very different. And I think any venture capitalist who thinks they're similar is either going to be very unhappy as a venture capitalist or very painful to the company they invest in, because it is not an operating job. Being on the board of a startup, at best you're a mentor, coach, and cheerleader. You are not calling the shots.

You are not saying what the business should do. You are not in control. You live vicariously through the successes of your portfolio of investments. And you can cheer them on but at the end of the day, the entrepreneurs deserve all the credit for building their business. And those few VCs that confuse that point tend to come from deep operating backgrounds; some of the best ones don't. But there are a few that sort of burn out and finish pretty quickly and are very frustrated in their having transitioned just from 10 years of operating experience into a board member role and realizing it's very different. So, EIR, for those who don't know, entrepreneur in residence, or serial entrepreneur are people who sort of have the habit of starting one business after another. So, they may not be as committed to any one business they start because they intend to start a lot of them. And so, perhaps driving the question was, "Well, maybe that's kind of similar to being a VC." But I think it's actually very different because if you're in the trenches, you're really responsible for the product, the service launching and everything. It's a very different kind and feel.

OK, cool. Steve Jurvetson: One more? OK, sure. Audience: That was a really interesting point, where you said a small group of really passionate people can overcome the rest of the investors. So, how do you sort of define that and can you talk a little bit more that? What processes do you have in place for when that happens? Steve Jurvetson: I'm a little hesitant... If we had any kind of trade secret, that would be it. Like at offsites, we spend most of our time talking about voting processes. And when we made a small change, like we thought, for example, that it would be a brilliant idea to have - it is a local dead spot - that if we had three partners that would all have to be passionately in support of a deal and would vote a 5 on a 1 to 5 scale where you can't vote a 3 so you have to make a decision which way you're leaning, strongly support or strongly oppose, mildly support or mildly oppose. If you had to have three 5's and any one of those three would be willing to take a board seat as a prequalifier to getting a deal done, we thought that would generate a very interesting dynamic about where the conversations go, how you schedule meetings, the pace at which we can invest, and we thought it could accelerate things. It actually slowed the pace of investment down dramatically versus having five partners for a variety of reasons. So, as a preamble we've tweaked so many different things.

The short version is what we found most successful is everyone gets a vote, they're all equal votes, of course. You have to vote at the exact same time. So, the key for not having group think is you can have one strong voice say, "I'm a 5," and then other people vote. It's like one, two, three, everyone show your hands at the same time so that you expose minority opinions more easily. So, there isn't any of that kind of overt pressure even though generally respond much to that overt pressure without laughing at each other more than towing the line. Nevertheless, it's an important parameter. If you didn't do that, everything will fall apart. And what we do is a simple voting tally. How many 5's are there, digging on the way a bunch of 2's? You just add it up and take the average. So, that's generally how we do it.

We've experimented with other things. We've had the "silver bullet", as it's called, meaning every partner needed a deal done with remarkably little friction as long as there's a small amount of money in each fund as a patch. In various points we've felt like something's a little out of balance. But the major thing is these simple rules, I think, are really important to business and I think about starting a startup will work in a large company. The way you set up the processes and architect the way communication occurs can dictate, I think, a lot of the emergent properties of the firm. Does it operate like a hive or does it operate like a bunch of swarming individuals? Can you tap into wisdom of the crowds or not? Can you in a sense build a business that's greater than the sum of its parts? And I think at Google, Gore and a bunch of other firms, you'll find that they'll break up teams with more than five or seven people. And in the development team, if you have more than five or seven

programs working on something, forget it. Board of directors - never more than seven people, if we can help it. There is a critical size-driven efficiency to emergent properties of firms that I think are really important in decision making. And how you orchestrate that or architect that can have more impact than how you manage its leader.

So, if we're going to go north, we're going to take that market. More important would be what's your voting policy; hence, the importance to your question. Thanks. I think that's it, right?