HOW TECHNOLOGY WILL CHANGE THE BUSINESS OF INVESTING

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In this engaging presentation, Ashby Monk discusses how fin-tech (financial technology) innovations originating outside the investment community are reshaping the investing process and financial ecosystem, as well as what investment opportunities (and risks) will come on line as part of the next phase in fin-tech evolution. Monk also presents technologies and skills that analysts and others should be looking to support or obtain if they want to participate in the coming fin-tech revolution.

Ashby Monk: Question number one: How many of you have used technology of some form — an app, a website — to meet a romantic partner, a spouse, a girlfriend? Please keep your hands down if you have.

[LAUGHTER]

All right, so I see only two people — oh, three. Three people have not. Four? It’s increasingly common that we rely on technology for some of the most challenging and uncertain and complex decisions in our lives. How many of you have used an app, a website, a piece of technology to source, screen, vet, diligence a deal, a manager? Anybody? This time raise your hand if you have. I’m blown away. All right.

Well, thank you for having me. I think this is the right crowd. You’ve self-selected. Most people would not have raised their hand. There obviously are many new platforms and websites that allow you to source, screen, vet, deal flow. Where I live in Silicon Valley, the most commonly used angel
investment platform is AngelList. And they’re really re-making the way in which we invest in early-stage companies.

So today’s objective is to provide some awareness — inspiration. I want you to leave this room, after two hours of listening to me talk, being aware of what’s happening in the investment technology area, and be inspired to go out and learn more and to open your mind to what’s coming.

I think you might be impressed with some of the things that are happening today. I think you’ll be interested to hear about some of the things that have been going on over the last 4,000 years of investment technology. And that’s where we start this discussion, 4,000 years ago. It’s pretty sweet.

And in this intimate setting of 400 people or whatever this is, we will review the very future trajectories of financial analysts. And I do encourage you to write down crazy questions that challenge everything I say. I do not purport to be an expert on everything I’m talking about.

My domain of expertise is on institutional investment innovation. That’s what I write about. The design and governance of pension funds, sovereign funds, endowments, foundations, family offices, insurance companies — what we would define at Stanford as the foundation of our capitalist system. This is the big pool of capital in the world. That’s my community. When I say “we” — and every once in a while, I’ll drop into, “Hey, we’re trying to” — I’m talking about those people, the asset owners, the long-term investors.

As James said, I’m a senior adviser at the University of California. I work directly with the CIO on all of our innovative investment platforms — UC Ventures, the Aligned Intermediary, which is about unlocking long-term capital for clean energy — all these different projects I’ve been involved with in that capacity. So I say “we,” I’m talking about that constituency.

Thanks to the organizers for asking me to do this. I’m super excited to be here. I’ve been looking forward to this, talking to such a smart bunch. You’ve intimidated me. I’ll do my best to live up to the remarkable knowledge in the room, make myself look not as bad as I fear.

My coauthors deserve a lot of credit. So I have a post-doc named Dane Rook. He is extremely bright. He’s back at Stanford. I’m sure he’s waiting on bated breath to hear how this goes today. And our other coauthor on this project is a guy named Daniel Nadler, who runs our fin-tech research team. And he also is the CEO of a company called Kensho, which you may have seen or heard about.

I’ve spent almost 15 years working with long-term investors. My whole objective in this project has been trying to help the biggest asset owners in the world be better stewards of their capital. And you’ll have to forgive me, because normally I’m much more engaging and I’m not reading.
But I offered to do this like a Ted Talk, with, like, the mic, and they're like, no, you should just read it. It's more professional.

[LAUGHTER]

Sorry, it’s two hours. I’m not that smart.

I think new technologies are going to help long-term investors get more aligned access to the underlying economy. I think it’s going to improve greatly upon the status quo. The work that we’re doing at Stanford on these new technologies really stems from a belief that the asset management industry is ripe for disruption.

It’s not just the asset management industry. More than the asset management industry is the asset owner industry, the “we” that I was talking about. Most of the time, the asset managers are filling a void that is left vacant oftentimes by under-resourced, understaffed pension funds, sovereign funds, endowments.

And so my hope is that technology is going to offer a whole lot of opportunities to help these long-term investors live up to the moniker that is “long term,” because there’s a lot of long-term capital in the world. Your slide deck said $100 trillion, because that was the OECD stat that we polled.

But after counting it up, we realized there is a little bit of double-counting. So it’s about $70 trillion in long-term capital floating out there in the world. That’s a wonderful amount of long-term capital. If you believe in the power of long-term value creation, the rise of sovereign funds, endowments, foundations, corporate pensions of all stripes with long-duration liabilities offers a truly unique opportunity to reshape this quarter-to-quarter capitalism that we find ourselves living in today.

Quarter-to-quarter capitalism comes with a whole series of efficiencies and gains, but we miss out on some of the innovation. And it’s those innovations that we’re studying at Stanford, and how to finance them.

This $70 trillion is really the target of all the work that I do. So whether I’m thinking about investment tech or I’m thinking about designing a sovereign fund, I’m trying to find ways to take that long-term capital and connect it with the biggest projects in the world — computer science, biotech, clean energy, infrastructure, water, you name it. These are long-horizon, long-gestation projects that are of existential importance. And we’re doing a really, really bad job of it.

We’ve got massive funding gaps in infrastructure — just not doing a good job. We’re not meeting the valleys of death anywhere near that, especially in the wake of the clean tech bubble and burst. These valleys of death in energy are punishing entrepreneurs in multiple phases and ways.
As a result of this long-term capital not behaving long term, we have a particularly troubling situation for the clean energy and clean tech investment worlds, where we're missing the stated target we need in order to prevent a climate crisis. And I find this particularly troubling, as long-term investors are the very same investors that will have to deal with the dislocations in the distant future if and when the climate crisis comes.

And I always feel obligated in sessions, especially among economists and financial theorists, to say, even if you don't believe that climate change is real — and there are people out there that believe this is a left-wing conspiracy — you are all risk managers. Are you 100% sure this is a conspiracy? Because unless you're 100% sure this is a conspiracy, you should be managing this risk in your portfolio.

We're risk managers. We squeeze return per unit of risk out of our portfolio. There isn't a single person in a long-term investment organization that shouldn't be thinking about what happens to their portfolio if climate change is real. That is, unless you're 100% sure this is all fake.

Beyond that — now that I've lost half the room, probably — we're missing water infrastructure. This is particularly important where I live today, California. We don't have enough water — so, once again, huge gaps in the investment dollars flowing through into these critical projects. Maybe you're starting to get a sense for why my research center is called the Global Project Center.

At the same time that we are missing out on these critical projects and not tying in this long-term investing, long-term investors — all $70 trillion worth of it; more sovereign wealth funds being established than in the history of all time in the last 10 years. Sovereign wealth funds — I feel like every single week, there's a new sovereign fund that's being set up. Illinois wants a sovereign fund. With what wealth, I don't know. But they're planning to set up a sovereign fund. That's the latest one.

But time horizons are shrinking. I mean, this is just a stat pulled out of the public market indices. But it's telling. In 1960, we were holding assets for eight years. In present day, we're holding it for half a year. Obviously there's an interrelated component of these anecdotes, or stylized facts. Maybe this helps to explain why we're struggling to finance clean tech and clean energy.

It's a global problem. It's not just American — shrinking time horizons everywhere. Problematic. At the same time that the $100 trillion — sorry, $70 trillion — is searching out for opportunities, bypassing the projects that we need financed, increasingly shrinking their time horizon, the financial services industry has become extremely lucrative. In 1950, the share of corporate GDP in the United States of America enjoyed by the financial services industry was around 8% to 10%.

Today, that number — this is a dated chart, but it's a lovely Economist chart, so I'll use it — is 35% to 38% captured by finance. This is an industry that isn't actually producing goods. It's efficiently allocating capital. And it's capturing 38% of all profits in America.
Let me sum up for a second, because I think it merits reinforcing since this is a master class. There are plenty of long-term investors in the world that want to deploy capital over long horizons. More than that, they are searching for ways to do so. They want to manage a liability that extends, in certain cases, out 50 and 60 years.

These long-term investors, however, are investing over shorter and shorter horizons. I find that odd. It rejects some of the key advantages of long-term investors. A long-term investor has an inherent advantage over a short-term investor. Why? Because it can hold the entire portfolio that a short-term investor can hold and more, the long stuff. So if we follow through the logic there, you can generate more return per unit of risk.

So this all plays into the hands of the high-cost intermediaries, which will end up being a component of this talk. What’s happening here? What does the role of technology have to do with any of this? Because that’s what we’re here for. Everybody thought they were coming to a talk on technology, and I’ve been telling you about governance and what’s wrong with finance. We’re getting there. It’s coming.

Let’s take a step back, like I often do with my students at Stanford, and just think first principles, about what it is this business of investing really is. All institutional investors produce the same thing. All investors produce the same thing.

I would say — and you can challenge me in your notecard-y challenges — that one thing is money. You’re taking money. You’re working to have these three inputs to be of the highest quality possible — the best people, the best information and data, and when possible, knowledge, because knowledge is simply actionable information and data — and then process.

What’s your investment decision-making structure? Do you have an articulated governance budget? You must have a risk budget. How do you innovate? How do you manage the tension between the over-focus on efficiency gains with the inherent contradiction of innovation? These are all challenges embedded in this process.

So, success ultimately will be about the quality of these inputs. There’s not a lot of research out there focusing on the specific combination or recombination of these inputs, and whether or not you should make or buy your data and information systems, your governance, from a pension consultant, your people from an asset manager, or some combination of those.

We can go back to Ronald Coase. We can go back to some of the fundamental ideas of insourcing/outsourcing, make or buy. We need to think about how to apply some of those to finance. So in terms of technology, you can think about this very basic production function and say to yourself, gosh, technology is probably going to streamline that process at the top.
Technology is going to help us collect and manage data and information in new ways and mobilize it, turn it into actionable knowledge. Technology is probably going to let us augment the people we do have in novel and creative ways. And I’m not just talking about dudes walking around in Google Glass. I’m talking about much more practical augmentation, man–machine in the domain of finance.

And so you can see from this production function why we’re doing what we’re doing at Stanford. What we’re doing at Stanford is working to improve this production function, which we hope will better align the long-term capital with the long-term critical projects in the world. Our focus — that is to say, my focus — is on institutional investment innovation, with a view to rerouting long-term institutional investors in the real economy.

And we take a normative definition of real economy as the people walking the hallways in Stanford’s engineering school. If you’re walking our hallways — if you’re doing biotech, chemical engineering, you’re building sustainable real estate, you are trying to figure out how to do PPPs, you’re writing code in computer science — we want to understand how to finance your future businesses. This is our constraint as a research center at Stanford.

And specifically, this leads us, after six years of playing with this research mandate from the dean of engineering, to four critical areas of focus for the next decade. This is literally our decade plan. Professionalization of asset owners — we’re in Canada.

Everybody thinks of the Canadian model as the benchmark of professionalization among pensions. I do not doubt that. The way the pension funds are being run here and Canada, and specifically in Toronto and Quebec, feel like businesses. It feels like it’s a professional outfit. More pensions, sovereign funds, endowments could at least learn from the principles if not the implementation style. Canadians with 1,000 employees and many global offices may struggle down the road to be innovative and dynamic. That’s not to say that they aren’t taking that professionalism seriously.

As a second thrust of our research is the re-intermediation of finance. As much as we think the disintermediation of costly managers is exciting and interesting, it’s rare. You’re probably not going to get disintermediated completely. I spend a lot of time working with county pension plans in California — Sonoma County, Contra Costa, San Bernardino, San Mateo. These guys are two individuals, a dog, a computer, and a consultant. They’re going to need asset managers for a long time.

But we can find them more aligned relationships. We can think about what it is to have true partnership. We can find a way to push back on what I jokingly often call the fee machine of Wall Street and get them a better deal. The asset management industry in the US is generating 41% margins after paying some pretty darn high salaries. It’s a good gig. But is that in the interest of the pension funds? I don’t think so.
And so lastly — and everybody will say “Oh, but it’s about net returns. It’s about net returns, Ashby.” But it’s not, because you don’t understand the incentives that you’re creating. And that’s partly why you’re getting the shrinking time horizons. It’s not about net returns. It’s about, what incentives am I creating you for that delta between gross and net?

Technological adoption — that is what we’re talking about today. You may not believe me, because we’re 15 minutes into this and I’ve barely talked about it. But that’s going to happen. It’s on its way.

It helps that we sit in an engineering school. Google was literally founded on our hallway. The colleague who runs my research center heard the first Google pitch, and he passed. And he’s going to be so bummed I told all of you that. He’s a lovely guy.

And so we’ve taken on this multi-year project. We think we need to understand all these cool technologies emerging from the Valley. And there are so many cool technologies. I’m going to give you a little bit of a flavor later in this session. But it’s astounding. I mean, the amount of technologies that are being built in industries that don’t even think of finance as in their domain but will obviously end up in finance is astounding. And we’ll talk a little bit about that later.

But before I do, I wanted to give you some of my foundational assumptions when I decided I wanted to launch this two-year research project and write a book about how pension funds can adopt technology. Sounds like a good book, right?

[CHUCKLING]

Assumption number one — most of the technology that has been built has been focused on speed — speed to market, the sort of maximum of the speed you can think of as the high-frequency trading. But it’s also speed to answers. You know the market you’re going for. You know the answer that you need to get. The inputs are there to get there. Just the technology gets you there faster. And with processing power emerging, we have seen speed get faster and faster and faster from 4,000 years ago to today. It’s incredible.

Until recently, inference — which is the other key pillar of investment technology I’ll be driving home throughout the next hour and 40 minutes — goes alongside speed. How much can you learn from the data, as opposed to how fast can we use the data to make a decision? Until recently, technological inference has been based on brute force — again, using speed to iterate on as many answers as possible. This is not computational understanding. You’re not writing evolutionary algorithms using machine learning, neural networks. I’m just saying words I barely understand, but it sounds good. That’s what’s happening in these places.

The inferential forms of technology to date were mostly about crunching data. And where sophisticated technology was actually being deployed, it was often hidden, hidden off in a black box
behind a 2 and 20, a 3 and 30, and no joke, a 4 and 1/2 and 50 fee structure. If you had the privilege of having access to that 4 and 1/2, 50 structure, you’d be a very wealthy person. That’s how insane some of these technologies are, and the advantages that they give. But because they were in a black box, they didn’t spread.

The other assumption that we had was that it was expensive. It’s hard to convince people to pay for this stuff. And when the benefits of these technologies are being reaped by the asset managers as opposed to the asset owners, then you develop this gaping hole between the capabilities technologically of the asset managers and the owners, because the owners say, what the heck? We’re not going to spend $2 million on a Palantir rollout to help us manage this data. But Bridgewater does. Many of the hedge funds can build this into their cost protocol. I’m sure it was more than $2 million.

So we had this thesis, which we believe to be true still, that the technology that we’ve been building over the last two years — sorry, 4,000 years, literally — was pushing the investment community towards shorter and shorter horizons. If your competitive advantage in the marketplace as an asset manager is some speed, you’re inevitably, even if you don’t notice it over time, going to shrink your time horizon to demonstrate an opportunity to generate alpha.

But the next generation of invest-tech, the reason we did this project, that seemed to be emerging out of places like Google, Facebook, DeepMind — which was then acquired by Google — offers a different type of technology and a different type of competitive advantage about inference. And it’s that difference between a focus on speed and a focus on inference that led us to decide we should study this.

So you’re caught up. This is the first time I got half an hour into a presentation and said, let me tell you what I’m going to say in this presentation today. Two main parts to this talk — what is invest tech, where does it come from, and what does it promise? And, why next-generation invest-tech still poses problems for investors.

So the real research project that I’m doing at Stanford is going out and collecting data and doing surveys and doing case studies of pension funds, sovereign funds, from around the world. How are you thinking about data? How are you managing risk? How are you taking advantage of your time horizon and scale and network to do things creatively with technology?

And you’ll be surprised at some of the interesting things going on. I was. Places that I thought were bastions of bureaucracy, CalPERS — doing very cool stuff. We had the privilege to spend time with the COO there, Wylie. And I give them all credit. I give CalPERS a lot of C-R-A-P a lot of the time, and they’re doing really interesting stuff right now.

As we get into this, let me give a nice quote from Mr. Carl Sagan: “We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and
technology.” Some of this is going to be obvious to people in this room. Again, you’ve self-selected here. Many of you are probably using technology in your day-to-day. Some of you not — maybe some of you are just working at a pension fund and were wondering where we go from here.

I am confused by half the stuff I’m reading, OK? And my colleagues are engineers and computer scientists in a department who are obligated to sit and try to explain it to me. So take a pause. We’re going to get to the end of this. If there’s questions, I’ll point you to smart people who can answer them. It’s probably not me. But I’ll at least point you there.

Let’s dig in. You’ve probably heard about fin-tech. You probably thought you were coming to a session on fin-tech. Right? Sorry. Fin-tech is the umbrella. Invest-tech is the subset. Fin-tech involves Bitcoin, Ethereum, ledgers in the cloud, payment processing — to a certain extent, some of the P2P lending platforms. I might even throw in there some of the robo-advisers focusing on consumers.

That’s not the world I’m interested in. I’m interested in the technologies that are going to help you — and I define “you” as investors, independent of whether you’re an asset owner or manager — raise your expected risk-adjusted net return, get your risks and your costs in order, and give you a better opportunity set.

I think it’s an error to view invest-tech as about boosting alpha through speed. In reality, invest-tech has the potential to permeate all organizational processes — that is, the entire business of investing. Remember my production function, with my wacky Neo and Matrix and stuff? It can change all of that. It can help us understand — I’ll just give a few examples — the true risks and even uncertainties.

Imagine we can start using invest-tech in the long horizon — uncertainty, data management processes — to convert unquantifiable uncertainties into quantifiable risk factors. Imagine we can use the enhanced understanding of the products that we get through this technology to pinpoint the delta between gross and net return, thereby truly defining the incentives that you’re creating among your asset managers.

And if you recall, I’m interested in long-term investing. And if I don’t know the incentives that I’m creating in my managers, how do I know if I’m incentivizing long term? I don’t.

Technology will give us a potential avenue to do more with less, and it can be augment far more than the production function. It augments the opportunity set, as well. But take note in this process — there is a thing called Moore’s law. And Moore’s law, inevitably will run into conflict, the more invest-tech that we use, we bring it on board, with Murphy’s law.

Moore’s law describes a theory, so far proving to be valid, about the rate at which processing speed will improve as a function of the number of digital circuits existing in a computing system.
Basically, it means that computers are getting fast, real fast. Murphy’s law says that anything could go wrong will eventually go wrong. So if you’re using Moore’s law to speed up processing and processes, be aware there is more potential for things to go wrong. Andrew Lo does a very nice write-up on the hedge fund industry in that regard.

So we’ve got a functional definition sort of about a purpose of technology rather than a pure definition, and we’ve got some context. And so now it’s time to actually dig into what invest-tech actually is. What are the characteristics?

Today we’ll be looking at next-generation tech. We’ll also be taking a step back and looking at some of the older techs. But ultimately, I would argue, for the future, these are the two key pieces of technology to keep mind of — artificial intelligence and big data. It’s a pretty simple breakdown. AI is about learning — new learning tools, machines, evolutionary algorithms. And big data is not just about bigger data, as in more data. It’s more kinds of data in nearer to real time.

And some of the case studies I’m going to get to about modern companies doing really remarkable things with new data will just show you how AI and big data are being combined to completely change the way in which we think about the world we’re investing in. That’s coming. It’s not too long.

So those are the building blocks. But all invest-tech can be characterized by two attributes, which I’ve already touched on briefly in this presentation. They are all pursuing two things, it seems to us: data latency — that’s speed; lower latency means faster — and inferential depth — how much understanding and insight can we get from the data and convert into investment actions and decisions?

Together, latency and depth determine how much of an informational edge an investor has in their production function for money. How fast are you, and how good are your insights? It’s pretty simple. If you look at all of the invest-tech companies emerging, they are targeting different components of lists.

In the ideal, latency and depth are complements. You’d like to see both. But more often than not, there are some substitutions. We can understand this better with a little visual analogy.

This is an analogy to an efficient frontier. The best quadrant is to be in the northeast — better latency, better inference. We can imagine the dotted line to represent the minimum combination of latency and depth that an investor needs to deliver on its mission. It might be able to trade off some speed for deeper inferences and vice versa, but sacrificing too much of either and moving too far west or south is untenable and should result in failure.

Likewise, we can imagine an ideal frontier, which is the solid line there, that controls for the all-in cost of the technology — the budget, the social and organizational aspects of the firm that is bringing that technology in — and place that technology on this solid line.
We don’t really know the shape of this curve. We’re just guessing. But it almost seems clear to us that it’s going to bow inward at the extremes. At some point, we have to trade off speed for better inference or sacrifice depth for latency. It’s just a simple framework for thinking about what the technology companies are optimizing for.

And importantly, it should be noted that where an investor would ideally sit in this efficient frontier depends on their own resourcing, their own challenges in terms of peers they’re facing off against, as well as where it believes future technologies are headed. And in the second half of this presentation, I’m going to show you a variety of approaches to how pension funds, a pension fund endowment, and sovereign fund place themselves — three organizations, all of them around 100 billion or more, thinking about their technology place on this chart.

It’s important to remember here, as well, this balance to be struck between Moore and Murphy. More speed is only better if you can control what you do with it. And control means understanding.

OK, shifting gears a little bit here — let’s get back to some of the basic building blocks. Where are we today with invest-tech? To better grasp where things are and where things are going, I think it’s important to study some of the highlights of history.

The point I want you to take away from this slide is that the main hallmark of invest-tech over the past millennia has been speed. I’ve said that many times. I’m going to keep saying it, because at the end, I’m going to tell you that the future is no longer about speed. So that’s the punch line. Get ready for it.

While some real headway has been made in deep inferences in isolated pockets of the financial community, such as in the quant hedge funds, the relative resourcing of technology has been about speed. So we are shifting from latency to inference. This may be right now — in fact, literally, weeks ago, with the AlphaGo event, meaning it’s like right now. We may have hit the inflection point. The rate at which the speed of technology is increasing may become less, or at least less important than the rate at which inferences are deepening.

The evidence would seem to us in our research that supports this notion that inference is about to take off. We are nearing a hard limit in the speed of data transmission. You can’t send data faster than the speed of light unless you change the fundamental laws of physics. But is there any such equivalent upper bound in inferential depth? Is there a maximum we can get to?

It’s hard to say, actually. I mean, we were noodling that one. Sufficient data, sufficient processing power — the inferential depth can take us a very long way.

Whatever the case, the computers are getting faster and faster. And that’s opening up more and more inferential options. Remember that a computer going faster doesn’t necessarily mean that
the invest-tech product is about speed. It just means the processing is getting better, so it can process more inferences or it can process more answers to go fast.

If Moore’s law continues to hold in this respect, the efficient frontier for invest-tech can be expected to continue to move outward on both dimensions, and very likely, more strongly in the depth and inference category. If we get quantum computing, it’s going to be crazy.

This inferential focus is being facilitated by a whole series of new artificial intelligent open platforms. They’re broadly and freely available. You may know of them as Google TensorFlow, or more recently, OpenAI. These are really just getting going. I mean, between us in the room — it’s a secret. Just joking. I know of two incubators in Silicon Valley right now in the process of being launched for companies to go and build AI technologies.

So that means every year, twice a year, they’re going to have batches of companies, like Y Combinator or 500 Startups that you guys, I’m sure, have heard of. But instead of them doing random apps, they are going to be building AI technologies. Twenty companies, twice a year, two platforms — that adds up. Some of them are going after finance.

It’s an interesting time. I’d say also, as an educator, I’ve been blown away by the uptick in interest in data science, machine learning, computational linguistics, symbolic systems — which is like Indiana Jones 101. It’s really fun. And related fields seem to be growing. And then there’s online courses, like MOOCs, and open, all focusing on AI and machine learning. So I think we really are seeing a swing in the trajectory of invest-tech that focuses more on this inference and this ability to dig deep and respond.

And so at this point, I want to take you back — I think you’ve got a little bit of a sense of where we are — and give you some history. Some of you may think invest-tech is new. If you do, you weren’t listening to the early part of this presentation when I said “4,000 years ago” three times. It’s old.

But to grasp the timeline — I’m going to come back to the old part in a second. We in our research team have been dividing up different eras. One is the before Claude Shannon, and the other one is adopting digital. And it all kind of comes down in 1948. And the division will make more sense when we get to the 1948 events and we talk about Shannon entropy. But for now, let’s just move through a progression of where this comes from.

Babylon: The Babylonians used reed stylus to etch pricing information of six commodities into clay records — barley, dates, mustard, cardamom, sesame, and — for the prize, anybody? Nobody’s going to get the prize. Wool. That was going to be a massive prize. Somebody lost out.

That’s not even the coolest part. The coolest part is they would correlate those prices to the flow and the depth of the Euphrates River — so literally trying to infer from the flow of a river 4,000
years ago what the price of these commodities are. Totally awesome and interesting, and the first case of extensive price archival with causal variables being linked.

I definitely would qualify that as inferential depth. Let’s put this on my spectrum — a little bit of depth, not a lot of speed. That’s just the beginning. We’re moving our way.

There is a famous story — which is a lie, but I will tell the famous story anyways — of the Rothschilds using carrier pigeons to transmit news of Napoleon’s defeat at Waterloo back to the trading floor to make a killing in the bond markets before anyone learned of the news. Lie. But cool lie, because it’s sort of grounded in truth.

The Rothschilds and other families and organizations were using carrier pigeons to communicate. They were putting little notes in these things and sending them across to buy and sell orders to markets. Not ideal. Sometimes the birds didn’t make it. That was a common problem. I didn’t get data. It’d be interesting to know the data on that. How many didn’t make it? It’s probably a redundant system. You’ve got like four birds with the same — anyway, just riffing.

Also not a lot of depth — you can’t put the cuneiform tablet on the back of the bird. You’ve got to fit it in that little doodad. It looks to me like you could probably get a couple of sheets of paper in there. This isn’t bad. So let’s plot this guy. Fast. I don’t think it’s got the inferential depth as our cuneiform, but it’s faster.

Next up — and you’ll note, by the way, that from the cuneiform tablet, going almost all the way to 1948, all the advances were speed, not really depth. One year after the invention of the telegraph in 1866, the first stock ticker was developed. This thing cost $1 million in today’s dollars to get it in your office, and it just [POPPING SOUND] ticked out stock prices. It harnessed the transmission speed of telegraph services to be able to provide a very fast information relay.

But once again, prices were recorded in an analog fashion, on paper. So they needed tons of human interaction in order to draw anything meaningful. You’re just getting isolated stock quotes.

Again, we’re getting faster. Time is going by. 1937 — the big breakthrough, the development of digital circuits. Claude Shannon, in what has to be one of the most amazing masters theses of all time — it wasn’t even a doctoral thesis; it was just a master’s — proved that any form of logic can be reproduced on a digital circuit. Foundations for intricate and extensive inferences from data transmitted and stored this way were now possible. It’s also reconfigurable in a way that analog was not.

This, we believe, was the beginning of the marriage between inference and latency. We’re starting to see speed and inference coming together in unique ways. It would take 60 years before the computer processing power got strong enough to do much with this marriage. It was a long, boring marriage for a long time. It’s getting exciting now.
Let’s spectrum this dude. There we go. Getting better.

Now, I am going to fast forward 60 years, to today. Two case studies I’m going to tell you — let me just disclose that I know the founders of both these companies. They’re friends. Please don’t rush out and use this as an endorsement of their product. This is simply very hard to get access to these companies. And so when you can get access as an academic, you call up your friend and say, “Can I come in and look at your company?” And he said yes.

So this is like a bias alert for everybody. That being said, what you’re going to see, I think, is pretty cool. There’s a company called Predata. And I want you to keep in mind, this is not the future. This is today. So this is not 10 years from now. This is all happening.

It offers a tool to listen to the social and collaborative big data and extract metadata. It then mines that metadata to develop signals. How much metadata is out there? A ridiculous amount of metadata — 3.7 billion people are participating in digital media conversations each month.

Bear in mind, the names on there — Twitter, YouTube, Wikipedia, Facebook, LinkedIn, Tencent — this source of data didn’t even exist 20 years ago — none of it — let alone the tool to analyze it. They’re using natural language programming to mine the social media in a way that is proprietary, they tell me, and generate unique signals.

How does it work? They score, they cluster, they tag, they sort, and they start developing inputs and algorithmic predictions. They literally predicted a terrorist attack in Mozambique. On a Saturday, their whole system went nuts. You can imagine who their first clients are. They’re out in Virginia.

[LAUGHTER]

Yeah. CFA. CFA, they’re in Virginia. I think it was Virginia Employees Retirement System or something. And on Saturday, they sent an alert, and on Sunday the terrorist attack happened. So it’s pretty wild what they’re starting to do.

They’re not alone. There are other companies that are doing similar things. Dataminr — Miner — is a competitor. Check them out as much as you check these guys out. Check out everybody. I’m not trying to give a plug, but I just think it’s fascinating that we can get a look to see how they’re doing it.

So these machine learning — they trace the patterns in this ecosystem in ways that we barely understand. It’s a bottom-up, crowdsourced platform that allows signals to emerge. In their estimation, this is far more predictive and useful than rating agencies or political consultancies. And chances are, this is going to be on the desk of every single energy company in the world.
Why not finance? Well, who knows? I don’t know yet. Why isn’t finance? They are talking to hedge funds, but their main clients right now are in intelligence and energy.

I would say Predata is sitting out here on the ideal — the combination of inference, the ability to create new signals from this data, signals that never existed before, combined with the latency, combined with the fact that there simply was not this data — this data was not even there.

Did you realize that every time you make an update to a Wikipedia profile, people know where you are when you made that? And so if you’re in North Korea and you’re pinging profiles for what happens after you shoot off a nuke, and all of a sudden one week, a lot of people in North Korea are checking the Wikipedia page on what happens when you shoot off a nuke, and then there’s a couple other things happening on the YouTube chat rooms, and all of a sudden they’re predicting a launch, which then happened? It’s pretty wild.

Next case study — again, a friend of mine. I knew the founder of this when he was at a company called Climate Corp, which is how I got to know him. He was very interested in climate insurance, using satellites to track crop yields. Which ones need insurance? Which ones don’t?

Orbital Insight today writes algorithms that takes observational data from satellites, pixels, and turns them into real-time insights about the world. The applications for this technology extend from farming to government and, as you might expect, finance.

Hedge funds used to pay people to sit in parking lots and count cars. That’s a real thing. They would pay people to sit at borders and watch containers cross that border in China, because they did not trust the Chinese data. That is a real thing.

Orbital Insights offers what they call a macroscope, which I just love that name. It’s awesome — macroscope, macroscope. Why? Because they are able to move us beyond all that accounting data, all that data that can be manipulated by companies and governments — market data.

Their antidote to that bad data is geospatial data plus machine vision plus parallel processing. And they are completely assisted by a boom in satellites. They have more extensive coverage around the world, and they have more intensive coverage in terms of trillions of pixels being pointed directly at Earth. You can think of this as Moore’s law in space.

What can you do with this? What does it matter? Is it just a neat-o anecdote, to have some parking lot being looked at by a satellite? Cars in parking lots and on roads have implications for revenue predictions for retail, for toll roads, crop coverage, growth and quality — another data input — agriculture commodities.
Smoke plumes at mills and factories gives you a sense for the scale of production and the energy being used. The shadow length at construction sites in China tells you how fast buildings are being built. The tops of those oil drums — I didn’t know this — go down and up depending on how much oil is in them. I thought it was just a roof. No, the thing goes down, which means there’s a shadow, which means from space they know how full the oil drum is, which means they don’t even care what people are saying they have in these drums. They know it. It’s wild.

Truck, rail, and barge movements are now being tracked, which helps you understand shipping and supply change. Cars in factory, cars in office parking lot — implications for employment. And all this data does lead to actionable intelligence. The idea that these guys are building is to build the sort of equivalent of an observational Bloomberg. The Bloomberg is the market, and it’s the accounting data. And it’s delayed. What they want to do is build the observational equivalent.

And that’s where they sit. So I’ve got three minutes before break. So before I do that, I want to teach you about three people. This is a class. You should know who some of the founders and godfathers of the industry are. There are three genius parents of invest-tech.

You remember I said 1948? That’s the year Claude Shannon’s work on information theory finally got published. He is the father of information theory. Shannon was very practical and theoretical. He proved that any logical statement can be implemented digitally.

He also proved a limit on how fast and how much information can be transmitted digitally in an error-free way. This is related to his entropy equation that we saw a few slides back. In essence, Shannon set the stage to allow inferential depth to become a more important factor in not only investing but computation for social purposes in general.

Next up, Jimmy Savage — statistical guru, breathed life back into Reverend Bayes’ century-old approach to updating probabilities. Savage literally wrote the book on Bayesian statistics in 1954. Bayesian methods are extremely prevalent today in machine learning and AI and other forms of prediction and analytics. Markowitz’s famous modern portfolio theory was only made actionable by Savage’s approach to probability.

Simon — yes, he won a Nobel in economics, but he is truly the godfather of AI in cognitive psychology, as well. In his work, he focused on making machines think more like humans. He produced for decades some of the leading models in machine intelligence, but he also stressed the limits to human cognitive abilities, what he called bounded rationality, especially in certain forms of reasoning.

Simon stressed that humans and machines were better suited to different types of reasoning, and that beneficial cooperation could come from divisions of labor between the two that catered to their respective strengths. We often label these types of reasoning as semantic and syntactic.
And so these three geniuses set the stage for this new future of invest-tech in which the semantic and syntactic start to come together. Machines used to be the syntactic. Humans used to be the semantic, with the understanding. But as we bring the two halves together, we get superior intelligence, yin and yang, human and machine coming together in a kind of cyborg reasoning. Sounds insane, but that’s what’s up.

Do you mind if I go another two minutes before we take the break? Go for it. Yeah? Because it’s blasting “time is up” at me right now.

I want to tell you a story about AlphaGo, and then I’ll quickly finish up. Go was thought to be too hard for machines. Literally, in 2016, they said it would be five years before a machine could ever beat a grandmaster at Go. Go is way harder than chess. I don’t know much about Go, but it’s tough.

Google, which had acquired DeepMind had built this algorithm called AlphaGo that used Monte Carlo tree search to find knowledge that this algorithm learned via an artificial neural network by training both the computer on other computers and people. It’s a hardware and software that literally mimics the web of neurons in the brain. That’s what it’s doing. Everybody got that?

Move 37, something crazy happened — the computer went off script. It had been training against itself. It had been training against people. And at move 37, it literally “did a move,” in quotes, that no human would ever do. And the best part of it? It was the winning move.

We have semantic understanding. We have a computer that is taking the single most complex game that we can play, that is training against itself and people, and it’s like halfway through and it’s like, I’m just going to stick a little tile up there. What’s up?

[LAUGHTER]

And he won. And so the world of AI has been buzzing with this development, because there’s an opportunity for a durable advantage — long-game strategies being developed, not the brute force short term. Powerful stuff.

But before we go, let’s splash some water [SWOOSH SOUND] so that you come back, so that you don’t think it’s all awesome. There’s amazing technologies coming. Are we ready? Heck no. State Street report shows us 44% of pensions think they’re using data effectively. They’re not. But 44% think they do; 36% admit to trouble integrating data with existing operations; 78% are training new in-house capabilities. There’s a future out there in which we use maps that are dynamic. We are still using paper maps in the investment sphere.

We’re heading towards a real-time dynamic bespoke platform of intelligence that understands where we’re going. I have a 4% real return target with this tracking error. I have a 40-year liability, and I
have an absolute return — whatever it is. Literally, we’re going to develop our own maps using these tools, based on the experience of our peers. That’s coming. That navigational world is on its way.

And I’m going very fast. The reality is we don’t have any of these massive companies in the invest-tech space, what we in Silicon Valley call unicorns. We don’t have it. We’re trying to find out why. We’re trying to liken it to the clean tech valley of death.

I think Palantir might claim to be a unicorn in the invest-tech space. There’s Kensho, which is getting close to a $1 billion valuation. We just don’t have those types of companies yet, which I find shocking given the scale of the opportunity in finance — 40% margins in asset management, 38% of corporate profits being collected by finance professionals in America.

Where are all these guys? Is it a VC mindset? Weirdly, VCs understand investing. They do invest. They just understand the business. That’s a very blanket statement that probably will get me in trouble. Technical founders not being aware of finance, institutional investors having a bad reputation for onboarding technology — probably all true.

But guess what? We don’t have those, but they’re on their way. Every single one of these companies are new. They’re all doing machine intelligence. They’re all doing it in different fields. And they’re all going to learn things they can apply to finance.

You will be surprised who gets replaced by robots. Including maybe you. You’re better off as an analyst than a brokerage clerk. But there’s work to be done. And so some of the work that we’ve been doing at Stanford is trying to understand how we help financial analysts pivot into the next generation of fin-tech and invest-tech and the world of finance.

And we say, you don’t need to be a producer of the technology, but you need to be a pro user. You will need to make the choices of which technologies to become expert in. In the same way in computer science kids are having to pick between Python, Go, C++, whatever it is — everybody’s choosing coding languages, and it binds them down a pathway — investors too will have to pick the platforms they become superusers on.

How many here can do Excel without ever touching their mouse? That was a big deal when I was growing up. One dude — me and you, man. Let’s see if we can do it.

[LAUGHTER]

The next one is the diffusion guru. These are working titles. I don’t really like the “guru.” This is the guy or the girl who understands how the technology will change the business. So think of the investment organization not just as an investment function but as a business. How do you embed
these new technologies? If you are a superuser of the technologies and you can understand how they fit seamlessly into the organizations, you will survive.

Before the break, we alluded to something that we are referring to, working title, the technological investor’s dilemma — working title. That is about the challenges being faced by institutional investors. By that, I kind of define it as pensions, sovereigns, et cetera, on when they start to bring these new technologies. We've spent an hour reviewing all of the interesting things that could and should emerge in the next decade, and now it's time to figure out how we implement it.

Innovation is when invention meets implementation. So it’s all well and good to have invention happening in other industries. If we can't find a way to implement it, and implement it in a deliberate, credible, sophisticated way, then we've got a problem.

We've been trying to think long and hard about how we help pension funds avoid getting eaten by the bear. We know they are going to adopt new technologies. We know it. It's already starting to happen. The number of large investment organizations that are spending $10, $20, $100 million on technology and data retrofits is now expanding into the 20s, 30s, 40s globally. This is happening.

How do we help these organizations not get taken advantage of, and build something that’s valuable? There are two cases, which I will not mention for their sake, in which $100 million was spent on two different systems that sit idle today.

Let that be a warning. Just because you have the resources and the buy-in doesn't mean you necessarily have the right technology coming in. And we will give you some insight as part of this section on how you can think about and how you should think about bringing technology within your organization.

To be a little bit more academic and rather than just chatty, I thought I would give you a little bit of a rundown of some of the research we’ve been doing. We are about nine months into a two-year project on investment-related technology that is multi-method that includes a survey that we’re going to be sending out in two weeks — my apologies. This happened too early for the survey data. But it will be published over the summer.

What we have done to date in the process of understanding what we wanted to ask was interviewed two dozen investment organizations — pension funds, sovereign funds, endowments, foundations, and that’s it — representing more than $1 trillion in AUM.

On the basis of those interviews with these organizations — specifically, generally with a chief technology officer and a chief operating officer, and in certain circumstances, the chief investment officer — we’ve tried to drill into the ways in which they think about onboarding technology. And
so this second half of the presentation offers you an update on some of the research findings that we’ve had to date.

Specifically, we’re going to be talking about the forms and features of next-generation investment technology that are needed to address institutional investors’ problems and objectives and needs. We are going to refer to the promise asset owners see themselves in next-generation invest-tech.

A lot of what I’m going to be presenting is actually the views of the asset owners themselves. We as academics get so much credit for going out and talking to really smart asset owners and then synthesizing their information, and then just re-presenting it to them. And then they’re like, “This is genius.”

[LAUGHTER]

And you’re like, “Yeah, you said it.” That’s what’s happening here today.

We’re going to review what some of the winners in our mind are doing to face the challenges of adopting these new technologies. So just to kick things off, I thought I would run through, based on these case studies and interviews, what we see at this point as some of the key lessons. What are the must-haves that the institutional investors need or want in the domain of next-generation invest-tech?

They want accessibility. Now again, what you’re hearing — just so you can have a little bit of context — is a synthesis of 24 organizations. So are there outliers? Of course. But this is the generic takeaway from the interviews and the qualitative data. They want accessibility. They want it to operate securely in a local environment.

The problem is that much of this is cloud based. So one of the big challenges that these organizations are facing is, how do you host locally when most of the big companies are building in the cloud? The Abu Dhabi Investment Authority wants to host it locally, I promise you. The Singapore Government Investment Corporation wants to host it locally, I promise you. Same with the China Investment Corporation and probably all the Canadian pension plans.

So how do you manage this process? Part of it is the requirement for these pension funds to get comfort with the cloud, or to find providers of the same types of services in a jurisdiction or geography that meets their strategic interests. Beyond accessible, we’re seeing real time as a critical component.

They want integrated solutions. It’s very hard. In the same way that many organizations end up with silos for assets and products, they end up with silos in investment technology. The risk management doesn’t necessarily talk to the accounting system, doesn’t necessarily talk to the whatever.
They want flexibility. They want these things to be robust, which they define as saying an ability to alter the inputs over time. Our views of the world change. Our technologies should support those changing views.

And then they need support. There’s a concept in Silicon Valley of forward-operating engineer, where they’re literally taking the engineers that help to write the software and deploying them to clients. Why? Because the technology has become so complex. It’s not enough to send salespeople. They need the forward-operating engineer to take it beyond the help desk.

And this is what the institutional investors are hoping for. What you see here is a traditional governance cycle. It moves around. You have a board that has a resourcing capacity. The board of directors pulls the strategic levers of success for any pension fund and sovereign fund endowment, and that strategic lever is resourcing and time. That’s the governance budget. That flows through into the strategy. And in turn, on the strategy, you execute and implement, and it feeds back into the governance.

Many of the organizations we’re talking to hope that this becomes real time, iterative, where the governance and the execution and the governance and the strategy are all dynamically playing off of each other. And when we get to the case of CalPERS, you’ll see that they’re literally trying to build something like this that throws away traditional notions of asset classes and tries to take a bottom-up approach to asset–liability modeling — using risk factors, but also being open to the idea that the data will show different types of factors. It’s pretty interesting.

So let’s dig into this technological investor’s dilemma for a second. We can describe it as a branching problem where every single one of these little nodes creates a new question and problem. The right answer, also sadly, is not necessarily the right answer forever. Again, things are changing.

It’s not necessarily an easy process. It’s a little bit, the way we’ve heard it described to us from a large sovereign fund is they view it as staying healthy. There is no fountain of youth. There is no elixir that makes you healthy. Instead, according to this one case, you need regular upkeep. You need to be constantly assessing your technological footprint, recognize there is no best option. All the options have constraints, and you’re in a constant phase of modernization and upkeep.

Is that fun? No, that’s painful. But that’s the reality. The status quo is constantly changing. We need to be aware of which direction it is changing in.

Ultimately, we’re trying to move to the northeast quadrant. And understanding the challenges associated with the selection of these triangles — we’ll call those different tools and technologies — was the genesis for us developing, with the help of some of our interviewees, something that we’re calling the ASIM cycle, A-S-I-M cycle.
So again, went out and talked to 24 organizations, the ones that seem to have a handle on their technology, who are running some sort of a process like this to bring it in. Again, recognize that some of the technologies they’re bringing in are literally, how do we get our data organized and cleaned and managed? And then other people are saying, how do we bring in these artificial intelligent algorithms to help us generate alpha?

So you can think of them as a spectrum of types of technologies. Most of the big pension funds we’re talking to are literally just trying to sort out the most basic problems, like we don’t even know if our data is right. They don’t even know.

So the ASIM cycle starts with this idea of, what are our ambitions? What do we want to adopt in terms of the new novel technologies? Many looked at something called an ambition gap. What’s our ambition for the future? What would we like to be doing? What are our priorities as an organization? How might we characterize solutions among novel technologies and products that help us meet those ambitions and priorities? And what timelines might it take to implement?

I have seen implementation projects take four years, and I’ve seen them take three months. It matters. In terms of sourcing, there is obviously a buy or build assessment that needs to take place.

Are you willing to go and take an off-the-shelf product — Aladdin or Addepar or any of these other relatively sophisticated data management platforms — or do you want to go to SimCorp and basically build a giant thing on your own? These are the existing decisions that these guys are making — buy or build? Obviously, even the buy, with SimCorp you’re having a service provider. You’re not re-creating the wheel all the way, but it’s a massive undertaking.

How are you going to search for these technologies? You clearly have a process and an RFP and a manager selection network and mechanism in place. You have your policy documents. Who are we looking for? What’s the tracking area? What’s the expectation? Is it alpha-generating? What are we willing to pay? You need a plan.

And part of the process in figuring out how to onboard new technologies was figuring out, what are we actually even looking for in a service provider? What do we want from them? What are we paying for? Are we paying for consulting? Are we paying for the signal?

Feasibility — this is a little bit like governance budgets. You need to check to see if you can actually do it internally before you go ahead and buy the license. Would you even be able to integrate the retail store data from Orbital Insight into any meaningful investment decision if you are a public pension plan? I don’t know, maybe. Maybe if you’re here in Canada. But if you’re in a Midwestern state and you’ve got three people working there, I’m not sure.
Contract structuring becomes increasingly complex, because who’s the fiduciary? How much trust and faith do we have in the signal that’s being communicated to us? As an investment signal, do we rely on this to send in a buy order? Do we integrate that into a broader system of investment decision-making criteria? All of these things come together.

And then we implement. We resource. We phase. We provide guidance to the management teams. And then we learn from our peers. You’d be amazed at how much peer learning is going on in this topic. I mean, literally in two weeks at Stanford, we have 35 pension funds, sovereign funds, from around the world descending to just talk about implementation of technology, from ADIA and the CIC guys all the way through to Canada Pension Plan. Ontario Teachers, I think, is coming. All of these folks are coming just to talk about, how do we implement this new data strategy?

And then monitoring — what are the performance criteria that we’re going to hold these folks accountable on? Are we being critical about the value we’re extracting? How do we modernize or regress? And then what’s the next? And then it cycles back around.

To help understand what we’re talking about, I’m going to walk you through, briefly, the CalPERS case study. CalPERS is in the process of conducting a really deep dive into the interplay between its data and its asset return structure and its liability structure. The aim is to unearth deeper connections between the asset return structure and the liability return structure, and to use the liabilities to more strongly dictate ideal portfolio architecture.

To me, it sounds liability-driven investing. Doesn’t seem that crazy? Until you realize they’re going at it by using big data analytics to pinpoint which assets are working well in the context of certain liabilities. It is actively looking to not only asset-identify but looking to re-imagine how it views the universe of possibilities. They are literally trying to take the labels off of their assets.

Ultimately, asset classes are just one among many ways to bundle assets. Obviously, they’re convenient and culturally accepted, and it’s a nice heuristic. But CalPERS is now seeking to move beyond. The challenge is, the factors the analysis spits out as organizing principles may not be investable.

They may not be interpretable. In the same way that people are still trying to understand how the Go game played out the way it did, CalPERS is getting outputs from its learning that it doesn’t understand. How do we assess longevity risk in the context of our investment plan?

Ultimately, CalPERS’ ambition is to build segments from the bottom up that are devoid of the straitjackets of top-down asset class architecture — and, in particular, with a view of minimizing hidden costs. If you’ve been watching CalPERS over the last year, you know they’ve been getting dinged on not knowing what the heck they’re paying. They’re focused on fixing that.
They’re meeting this objective methodically: They’re decomposing asset classes into factors, and then they’re comparing the factors across the portfolio in order to reverse-engineer the ideal portfolio — again, using big data, using new procedures and technologies. That was a demonstration of the adoption decisions. They had an ambition. They had a mission. They characterized what solutions they would like, and they stipulated timelines, and then they moved into sourcing.

For the sourcing case, I’m going to talk a little bit about AIMCo. These data are old, because these data reflect the time when the projects were launched. This is an old project. I think it was launched in 2011, 2012.

Four hundred people overseeing $75 billion in assets for 26 clients. They found some accounting problems. Those accounting problems cascaded into a realization at how screwed up the entire architecture was. And it was then said, all right, let’s never waste a good crisis. Let’s rebuild the thing. Let’s make this competitive disadvantage into a competitive advantage.

They started to view this data information warehouse, DIW there in the middle, as the brain. Everything flowed to the brain. And on top of the brain, we would build new apps, new capabilities, data efficiency — cleaner, faster, better. And they did it in a Big Bang approach, where it was like, remember when the Swedes were driving on the wrong side of the road and then one day they were like, let’s drive the other way? Remember that one? Anyway, that’s like what they did, except it wasn’t driving. It was data.

One day, they flipped the switch and the entire thing turned over from the old platform to the new platform. So you think about how big a deal that is for an $80 billion organization to flip a switch on one day and move over to an entirely new architecture. They had a team of 40 people sitting in an off-site building for a year and a half, building that plan and implementing it.

The other case study I’d like to flag is the University of California. There’s a reason I’m picking these two specific cases. The University of California is a similar size, similar multi-client model, long horizon, running a public pension fund, running an endowment. Instead of 400 people, maybe there’s 60 people.

But there was a few different priorities. Yes, it was a different geography. Yes, it was a different resourcing method in terms of this being a regional committee of California and AIMCo having a Crown corporation board resourcing — so different levels of resource.

Different objectives — the UC was not about having a central brain. It was about maintaining agility and continuing to iterate and flow over time. And they went a completely different path. They decided not to just buy. They bought in fully and developed deep relationships, are in the process of continuing to build deep relationships with technology providers from the outside. They did not have a team of 40 people sitting in an off-site waiting to flip the switch and say go.
AIMCo was after data integrity. UC was after risk monitoring. AIMCo had a big budget. University of California had a light budget. Very different implementation styles, very different technology solutions — the exact same team did both of these.

So Jagdeep and Arthur ran AIMCo’s technology transfer. They moved to the University of California. Jagdeep is now the CIO and Arthur is now the COO, and they run the exact same project at the UC — same team, same beliefs fundamentally as individuals, demonstration of how unique the technology has to be to the organization.

So when you’re thinking about the sourcing and the implementation, it’s not just about a generic discussion of what’s right and what’s best. It’s what’s best in context. And they think they did the right thing at AIMCo. And they think they did the right thing at the UC. Time will tell in both cases.

Again, buy versus build assessments were very different. Search plans were different. Implementation plans were different. In thinking about buy or build — and there’s a mistake on this slide on the budgetary impacts — we have noticed there is a constant return to these logics among the operational teams of the sovereign funds and pension funds.

Many worried about the impacts on liability — confidentiality issues, as in liabilities. We have to keep data confidential. We are dependent on a third party to control our data. Are we living up to our fiduciary duty by allowing our data in the cloud? Things like this.

Budgetary impacts — that’s supposed to say financial budget, risk budget, and governance budget. OK? If you’re building it, you’d better have a heck of a governance budget. And by governance budget, I mean a board bought into the idea that you’re going to spend $65 million to build a technology platform.

That’s what it costs, which is insane — which to me is like, where are the entrepreneurs coming to build companies to fill this gap? Because I can think of 10,000 organizations that need to spend $60 million on data. Does nobody want to start that company? It’s crazy.

Systemic impacts — these organizations are worried about being a differentiator. Or do I want to be in the pack? Do I want to disintermediate or re-intermediate? As in, do I want to use this technology to better identify opportunities, or do I simply want to work more collaboratively with my managers? I’ll update that slide for the binder, or if there is a binder.

And so lastly, I just wanted to reflect briefly on the monitoring protocols. This is not the end of the line. I would almost argue monitoring is the beginning of the line. It’s the trigger that restarts the process.

Are you being critical about the state of your technology? How many of you still run portfolios in Excel? Don’t raise your hand if you do.
[LAUGHTER]

That’s what I thought. It’s a problem.

OK, now we’re getting into some cyborgs — must be getting near the end.

All right, trust is important in finance. Trust, in fact, has been a heuristic in finance for as long as finance has existed. Whether you were a local banker on the prairies or a sheik in the Middle East or an investor in China, trust matters. Hard to quantify. Hard to articulate and write into explicit contracts. But it’s remarkable how often in my research trust emerges as a theme, in almost everything.

How do you seed managers? I build trust. How do you pick co-investment partners? I build trust. How do you know which startups to invest in? I figure out if I can trust them. It’s insane how often interest emerges.

How do you build trust with a robot? It’s hard. It’s hard. What is the legal status of a robot? How do you write a relational contract with a machine?

I mean, I was joking this morning to somebody that I feel like we’re in the process of writing a trade deal with invading robots, and we’re trying to figure out how to work with robots right now, because they’ve got this neat product that they want to sell into our market called AI. And we want it, but it’s probably going to blow up a lot of your jobs.

So are we going to get retraining for you? How does this work? Because if that little robot dude actually lives up to the promise of artificial intelligence and machine learning, 15 years from now we’re all going to be retrained into something. And so how do we trust this thing?

And this is the big challenge for a lot of the work that we’re doing around relationships emerging between long-term investors and technology companies. And there are some initial forays taking place right now. I know of a large endowment in the Bay Area that is digging in with some of these technology companies trying to understand if there is a path to replace an asset manager with a tech firm.

And it actually so often boils down to this relational contract. Who am I talking to? Who is actually responsible here? Who is accountable when I use your information and I fail? Obviously, it’s me. But do I share that with you? How do I get buy-in from the board? How do I explain to the board? You think you’re having trouble explaining to your boards if you’re a pension CIO, a hedge fund strategy? OK?

We don’t even know what AlphaGo is doing to win. Now you’re going to go tell him that you’re going to rely on an intelligence that you don’t even understand to develop a trading strategy? So
there’s a whole lot of relational contracting issues that need to emerge before this becomes viable in the mainstream.

That goes back to the monitoring — constantly scanning horizon. I hope we’re done with that. Good.

All right, potential futures — we are now summing up, James. I just wanted to let you know. We’re going to have time for some questions.

There’s a bit of a Goldilocks problem here. What happens at individual and systems levels if there’s too much building and not enough knowledge-sharing versus too much buying? It’s very hard to undo things that you’ve done, especially in the context of pension funds. But do you want to be behind?

I think what I’ve noticed is there’s this constant — it’s funny, actually. I’m just realizing it. It mimics the behavior of personal consumers of iPhones. You’re all like, no, I’m cool. Literally, my iPhone has a big crack in it and I’m like, I’m cool with it. There’s going to be a new one. Because I don’t want to pay $100 to get a new screen, I’m going to get a new iPhone.

These sovereign funds and pension funds are like, no, no, no, there’s going to be a better — the data platform’s getting better. I don’t want to spend $100 million right now on a data platform. That’s insane, when like two years from now the new data platform’s going to come out. But at a certain point, people need to jump in. Otherwise, you’re still like every single person in the room who didn’t raise their hand running on Excel. All of you — I am going to write a post about 100% of the CFA doing their portfolios on Excel.

All right, the next thing that we’re sort of witnessing as people begin to understand what technology can do is this gradual extinction of asset class–based allocation. The neat thing, from my perspective, is the ability to start building out one team, one portfolio, which we often use in the world of pension funds as the holy grail. Wow, I’m going to learn from the real estate guy what’s happening there. That’s going to help me figure out my fixed-income bet — or whatever it is, right?

There’s an opportunity to make that real. It’s very hard to do today in asset class silos and buckets, where everybody’s trying to do their deal. As inference gets deeper and allocation approaches change, what happens to the number of holdings per portfolio? Does it increase? Do you hold more, or do you hold less?

So do you believe Buffett, that diversification is a crutch for people who don’t know what they’re holding? Or do you believe five Nobel prizes, which says diversification is a risk-free opportunity, like free lunch? These are questions that I hear people asking now — how much do we owe? Now
that we truly understand the asset and we think we understand it in many other dynamics and can actually model it out into the future, maybe we hold fewer.

Ultimately, we expect to see closer alignment between asset managers and asset owners. We think rather than being a threat to the asset managers, I think this could be the catalyst to set the table the way it should have been set. The financial services industry is capturing too much value. It’s amazing. If you lived it, good for you. Take me on your boat sometime.

My favorite question in these types of meetings is, who flew private? Who flew private here? No, this isn’t that kind of crowd. But it sometimes is.

Let’s summarize. Things are changing. The main forms these changes are taking are technological — specifically, focusing on the latency of data and the increasing depth of inference. Together, my hope is these changes are encouraging technology that allows the business of investing to be more grassroots driven — bottom-up, empirical, evidence based, where decisions are made objectively in a defensible, well-reasoned way. That’s what we’re doing at my research center. That’s the mission. This is why we’re interested in technology.

More importantly, this trend could allow capital to be channeled in a way that is better purposed towards the missions of asset owners — bespoke products, tailored, unique. It’s not a one-size-fits-all.

The new abilities these technologies allow should force asset owners to re-examine what their own missions are in the first place and examine how they are executing on those missions versus what they could do. As we know, long-term investors could be longer term. As the power of inference emerges, will we see an extension of the time horizon that we saw creep down as the power of latency emerged? Maybe. I hope so. Maybe it will take years for some of the inferences to realize. And so you buy it, and you hold it, and you wait.

We can’t see everything through rose-colored glasses. If there’s anything that I’ve left you with, I hope it’s a combination of optimism for a future that could involve you, a path to involve you in this world of investment technology. But there are so many challenges ahead to bring this to fruition. There’s going to be a lot of disruption.

Schumpeter was right — to be a winner in this space, you need to sort of wrap your head around this technological investor’s dilemma, figure out what you need, where you’re going to get it, how you implement it, how you monitor it, and start it all over again. It’s a never-ending cycle, in the same way that the iPhone in your pocket today is not the iPhone you’re going to have in your pocket four years from now. It just isn’t.
And on the individual side, I would say finding a way to be a superuser — what we would call a pro user — there is no need to be a producer of this technology, but becoming a pro user, choosing the technologies that you think are going to be a competitive advantage for you in your job, and spending the time to get up to speed. There’s a whole bunch of new platforms emerging, whether it’s Orbital Insight, Predata, Kensho, you name it. There’s tons of early-stage companies that are going to be disruptive.

And then understanding the social science aspect, because none of this gets plugged in and used effectively if we don’t have governance, if we don’t understand the biases that it’s creating, and if we don’t truly find a way to make this a positive for the ultimate objective, which is providing retirement security, which is reinforcing the health of endowments, which is building up giant piles of money in foundations. These are the objectives. And I hope this will play a role. With that, I'm done.

[APPLAUSE]

**James Benoit, CFA:** Join me here? You want to sit up there?

**Ashby Monk:** I'm going to sit down, yeah.

**James Benoit, CFA:** You need a break. That was fantastic. I've moderated a few of these sessions or types of sessions over the years. The master class format is a new one we've been putting in place for the last few years, and I think you nailed it. I think the breadth of perspective you put into what this industry is the beginning with the depth and the rest of it, I think, is really what this class is about.

From some of the comments I had in the break and the questions I'm seeing, which come from people who are from physics backgrounds and all the rest of it, there is a lot of concern, confusion, worry. How do we deal with this?

**Ashby Monk:** Pretty standard from my presentations.

**James Benoit, CFA:** I didn't say that specifically. But I question — and I talked to some other people in the audience about, we're people. We are now being really affected by this, whether we're a pro user or producer, et cetera. So for people who now want to make, really — understanding, I think what we've created is a sense of urgency, that this is a revolution which is now really upon us and studied in a way.

How do we practically get more educated and protect ourselves, in words to deploy this? What are the sources you can guide us to in terms of how we start to really grapple with this? It's nice that we go away from here and hear about it, but how do we keep to date on this?
Ashby Monk: To give everybody credit, it’s hard. Weirdly, we look more in parallel industries — so there’s the two parts. What are the technologies? We’re not looking at finance. We’re looking at parallel industries to finance. Why finance continues to be a slow adopter boggles my mind. The amount of profit that can be generated by one — it just boggles my mind.

So we’re looking at health care. We’re looking at traffic management. There’s all sorts of interesting tools, like agent-based modeling, which is going to have profound impacts on the way we think about financial crises cascading through markets, which was drawn from traffic patterns.

So it’s about trying to understand, what are the technologies that are emerging, taking a leap — which, thankfully, I’m in an engineering school and not in a traditional academic department, so do whatever you want, Ashby, and take that leap. And then, thinking about how we might adopt those in the context of a long-term investor. So I don’t know if I answered your question, but I answered the question I wanted to.

[LAUGHTER]

James Benoit, CFA: I think that you touched upon the fact that, is it because, the margins? And we know that certain big firms maybe, as you say, have kept this technology in a black box. Is there inherent principal–agency conflicts, which just until the technology becomes so much more pervasive that that’s been shielded from us?

Ashby Monk: Well, there’s some interesting quotes from Jamie Dimon the other day, sounding the alarm on all these democratized technologies that are providing cheaper access. I think there’s probably something to the effect that the more profitable and massive an industry is, the harder it is to disrupt. If we learned anything from the clean tech bubble and burst, size of market isn’t necessarily the good thing. OK? Having a little niche market that you can go in and crush and then expand into parallel markets is probably right.

So there is a fear here that the behemoths keep this at bay. But thus far, the behavior, if I’m honest, is they invest in them. Some of the best invest-tech companies I’ve seen, their cap table has Goldman Sachs, Fidelity Family Office. These are the mainstream banks working with the upstarts.

James Benoit, CFA: OK. A lot of the members here in the room are in the private wealth side, as well. And you made a comment about being a pro user versus a producer. But is there a way for those in the private wealth side to take this and have a much more powerful platform, or even can compete against much bigger asset managers? How do you see the private wealth, private banking side of the technology moving?

Ashby Monk: Yeah, I mean, I think on the one side, people are kind of nervous about the robo-advisers. And I understand that. And I only raise that because I think there’s a lot of fear about
what that implies, but also, the fundamental technologies that are being built up in those, what are basically index funds — the assets that are being originated creatively and then dropping them in index funds — also augur innovations that can empower just financial analysts.

Why did Goldman Sachs invest in Kensho? Well, because they wanted all of their wealth managers to be able to sit in front of this next-generation technology and type in, with a natural language search, “It was snowing for two weeks. What’s going to happen to Netflix stock?” Now, is that the best trade you could do in the world? No, but it’s probably a conversation starter for the wealth management people back with their clients.

And so I think there are going to be a variety of innovations that help bring these tools out of the black boxes and into the offices of everybody. And that’s a good thing, I think.

**James Benoit, CFA:** And there’s a related question on that, in terms of, for a smaller asset owner, then — is the simple answer just to go passive? Kind of avoid the costs, just do the passive strategy?

**Ashby Monk:** How small are small?

**James Benoit, CFA:** They didn’t ask. But they’re just saying, is that a simple answer for smaller of us, just to wait and see what happens, I guess, until there’s more clarity? Just go passive-ish?

**Ashby Monk:** So I’m going to get some of the facts wrong here, but I’m just going to say it anyways. There’s an Indian tribe in Colorado that has $2 billion under management and has 800 staff and runs 100% of it internal. I think it has less to do with the size and more to do with the governance and the mission and the return target. If you have a return target of 8.5%, like some pension funds do, how are you going to do that? I mean, you have to get Wall Street out of the equation at that point. It’s too costly. The whole Hail Mary with hedge funds — I mean, it’s a joke.

So if you had an 8.5% return target, you’d build your own private equity firm. That’s what I would do, or build the next-generation endowment. Now, if you’re a university and you’re $4 billion, and your university happens to be like a Williams or an Amherst and your network is ridiculously strong, then again, I would probably tap that network to the maximum and not go passive.

But if you’re sitting there in middle America and the board doesn’t understand what you’re doing, and you’re reporting in to policemen and firemen and teachers, who mean well but don’t quite have the knowledge and expertise — passive.

**James Benoit, CFA:** OK.

**Ashby Monk:** How’s that?
James Benoit, CFA: I think that works. And a few people had some questions, again — for example, going to the bigger side now. If I’m CalPERS, how do I avoid the risk that some of the risk factors that have been identified by the machine are just noise with no predictive value? I mean, that’s from someone I know who has quite got a very sophisticated technical background. So I think we really are all grappling with, as you say, you’re spending $65 million. How do you know what you’re getting out of that at the end of day?

Ashby Monk: I don’t have a good answer for that. I mean, I hope there’s a redundancy in the process and that it’s validated nine ways from Sunday before you move $350 billion. But I’ve seen pretty crazy things, and who knows?

James Benoit, CFA: Because a similar question, or a follow-on from that — so then, does it matter if we understand the solutions that these systems find, or is the fact that they work sufficient? It’s like, I don’t know how my phone works, but it works.

Ashby Monk: Yeah, well, that’s Carl Sagan, right? I wonder how many of us could explain all of our hedge fund investments, really. So I think people have become accustomed to the notion that we don’t really know where all the returns are coming from. Can people really figure out the attribution on our private equity portfolios? I think that’s another travesty.

My hope is, frankly, that this technology allows for an auditing trail that helps you get attribution. Because everything is constantly being quantified and assessed, we may actually be able to start to define those moments of attribution. I mean, I would be astounded if somebody in this room was like, “We’ve figured attribution out. We’ve got it. We know when we make a decision and what those results are.” It just doesn’t happen. There’s too much noise.

James Benoit, CFA: And you sort of touched on that earlier, and the question comes to that. So it seems like a lot of the efforts are focused on the pursuit of alpha, but maybe it is those other efforts on distilling what’s in the beta, the systemic error — inflation, GDP. Although, you could make a case from what you’re saying, that GDP and those kind of measures increasingly might be just irrelevant, because there’s going to be such an overturn of source data. This is not a fair way to say it?

Ashby Monk: My gosh.

[INTERPOSING VOICES]

I’ve got a barge that we can go move on off the coast of San Francisco. That’s a real thing.

Yeah, I mean, I think all of this is meant to supplement and hold accountable. Like, OK, a lot of the problems in this business stem from a lack of transparency. It’s not that the people are doing the wrong thing. It’s that they don’t have the right information, the right data. We don’t truly
know — or at least we didn’t until recently, for example; and I know I’m harping on private equity — what they’re charging us.

The FCC did this investigation and found that the real number is actually 70% of the private equity GPs were overcharging LPs. Why? Because they were registered in Delaware, and they interpret their fiduciary obligation to mean that any single area of the contract that is not explicitly defined can be interpreted in favor of the GP. And the federal government was like, eh, wrong. That’s actually a fiduciary obligation for you to define it.

So things like this, where you’re like, well, what are we doing with GDP? What are we doing — all of this information, when it’s exposed, will change this business, because we’ve gotten away in asset management getting paid extremely handsomely on the back of inefficient data and unknowable things.

**James Benoit, CFA:** And there was questions addressed that. So you’re right. As we start to get that data more open and transparent, will there be counteractions to then protected firewalls put up, so people will not let you see some of that source data? Will there be a counterattack to shield that so people can protect? Whether it’s a government or whether it’s other people making decisions, will they try and find ways to disguise other people seeing the data?

**Ashby Monk:** Totally. But so I think this was the irony of finance. It’s like we’re all sitting around here, and 100% of the room is using Excel for spreadsheets.

**James Benoit, CFA:** We haven’t proven that yet.

**Ashby Monk:** Well, we did a poll.

**James Benoit, CFA:** Should we do a poll?

**Ashby Monk:** And we’ve got all these managers that are like, we’re going to lock you up in contracts. You can’t talk to anybody. This is not even an NDA. This is a trade secret, right?

Well, the trade secrets are about data, information, management, fees. And here we are, and these people are all investing in these tools and technologies for managing information and knowledge and data and keeping us siloed, trying to block the passage of information. And yet it would be in our interest — we, if we’re all pension funds — to actually try to blow that up. And how do we blow that up?

Literally, how do we blow that up? Is it governance? Is it regulation? Or does the technology just make it freaking impossible for these people to get away with it? “What do you mean, you’re not going to tell us this? We’ve got a technology platform that’s going to assess it for you. Just say yes. Tick a box that says yes so that we have it.”
James Benoit, CFA: So why is it taking us so long to get it —

Ashby Monk: I’m getting fired up.

James Benoit, CFA: Yeah I know. That’s great.

Ashby Monk: I’ve got to calm down.

James Benoit, CFA: That’s fine.

Ashby Monk: Sorry.

James Benoit, CFA: No, that’s good. Because there’s a few comments that came in and said, neural networks and AI — there was lots of popularity 20 years ago.

Ashby Monk: Do you want me to tell you about neural networks?

James Benoit, CFA: I’m just saying — so is there an impression there’s two lost decades of work on this? There was quite a lot of stuff.

Ashby Monk: Yeah, I mean, I don’t know what’s happened. I know that the processing power gets crazy. Oh, I don’t have my phone. But in 1979, Rentech — the story is, I don’t know if it’s true; it’s all so secret — spent $100 million on data infrastructure for their fund. A hundred million dollars in 1979, undoubtedly doing some sophisticated quanta analysis, inference, and latency. That processing power fits in your phone today.

So it just wasn’t possible before. This goes to that aspect of prohibitive. Was all that research wasted? No. I mean, we got some great movies out of it — Matrix, Terminator. It’s very good.

James Benoit, CFA: OK. I think that goes to the definition, though.

Ashby Monk: This is a long session, just noted.

James Benoit, CFA: 10 more minutes. No, I think it’s been great. And look, everyone’s still here.

Ashby Monk: Kudos. Kudos to you guys.

James Benoit, CFA: What you did is, you said, this is invest-tech, not fin-tech. And I think that was important, because a lot of people will come in with that impression. So for example, just to help us, is Bloomberg then a fin-tech company?
Ashby Monk: Remember, yes — invest-tech is a subset of fin-tech. So it’s all fin-tech. It’s whether or not it’s invest-tech. So I would say Bloomberg is an invest-tech company. It’s just not very good on inference.

James Benoit, CFA: There’s such a wide range of, I think, people searching for information. So again, why isn’t Google then telling us or giving us more insights into their search activities, given that they’re the eminent player in every industry? So I think a lot of us are just trying to really — where are the margins, and what’s in this industry?

Ashby Monk: So, more secrets?

James Benoit, CFA: Why not?

Ashby Monk: Google is building a big finance push. Google’s coming. So, right now? Fine, they’re not giving you all the data that they’re collecting with their keywords and all that, but they’re doing a lot. The rumor mill has it that they’re doing quite a lot in the investment sphere and will in the future probably be sitting in this room.

James Benoit, CFA: Well, again, just as you were mentioning some of the companies that you were working at on the beginning of presentation, people were asking questions. So where do you think the most exciting innovation then is coming in terms of all the areas you covered? Is there one particular area where we could focus in on — companies or countries that are working on that? For example, I’m sitting in London. London is fashioning itself supposedly as a fin-tech place and doing lots of stuff. So it seems like the revolution’s upon us, and I think we’re searching for, how do we go capture that.

Ashby Monk: Yeah. I mean, I think there’s going to be a really interesting opportunity for people all the way down to the individual to tailor portfolios in ways they have never been tailored before. All right, millennials are millennials, and there are companies emerging in Silicon Valley that are going to help millennials say, “I don’t want to invest in tobacco or alcohol,” and do so on the fly in a bespoke product.

I think that’s interesting, because I think actually, the more people we get in the world breaking the convention of modern portfolio theory and this idea that extra-financial reduces returns, I have a real sneaking suspicion that we’re going to find some extra-financial inputs that accelerate returns.

And now that we’re going to have a whole bunch of millennials out there saying, “I don’t want to invest in pornography” or “I don’t want to invest in” whatever it is — the man; maybe the man is going to be a screen. That’s a business idea. Come see me later. But then what are we going to have? We’re going to have this laboratory where we’re going to see all these different young investors. Maybe they’re foolish. Maybe they’re not.
I think one of the big projects I’ve led over the last two years is to try to unpack what the heck sovereign development funds in places like Singapore, Malaysia, South Africa did right, because they’re generating double-digit returns while delivering on development, which is, our theory would tell us isn’t possible.

**James Benoit, CFA:** So you're really going right at the heart of modern portfolio theory, which is at the heart of our curriculum here. So I think this is deep stuff for us.

**Ashby Monk:** That’s my cue.

**James Benoit, CFA:** And a question someone else asked, though, again — for the long-term horizon — and you’ve mentioned a bit about using the, not so much speed, but again, if we are focusing on using technology for long horizons, does it need to be real time? Or is it more important to get the inference, and it doesn’t matter if you get it a month later?

**Ashby Monk:** There is literally a new venture platform in Hong Kong that is using artificial intelligence to help it pick drugs to back with a 15-year horizon. So how do we understand which drugs we should back? Very hard. And obviously, there’s a lot of people trying to figure it out. But the biotech industry has, like the energy industry, suffered from that valley of death. So if we can’t understand it, maybe the robots can. And they’re trying to figure that out.

And so that’s one of those circumstances where it’s like, all right. Inference could extend time horizon. That’s the holy grail. We take that chart that’s gone down like this from 8 years to half a year because of the amazing processing power that’s been developed over 50 years, and we send it back up by empowering these long-term investors in ways that we can’t even imagine.

**James Benoit, CFA:** Time for a few more questions here. We ran over a bit. But someone was also asking, as you mentioned, those industries — what’s the impact then on real estate? Is there some way this really changes the way real estate investing can be done?

**Ashby Monk:** Dude, I love the real estate. There are really cool companies emerging. One of them is a colleague of mine at Stanford called Brain of Things. And Brain of Things is building an artificially intelligent apartment. How do you like that? You wake up in the morning. It noted that you drank a lot of beers last night, and it dims the lights as you’re getting up.

[LAUGHTER]

That is a thing that’s happening. We can all look forward to that. That’s probably not what you were talking about.

**James Benoit, CFA:** Well, it is, because we’re building buildings, which have always been built.
Ashby Monk: Imagine it syncs to your calendar and it’s like, “Hey, romantic night with the wife,” and the lights go pink.

[LAUGHTER]

That’s happening. Today.

James Benoit, CFA: It makes us think what we’re building then, doesn’t it?

Ashby Monk: Sure does.

It’s got to have all that stuff in it.

I think the implications for these people are very important from that.

James Benoit, CFA: Good. Last question, just summing up — I know it’s been a long session. Thanks very much.

Ashby Monk: It’s been fun. Thank you for having me.

James Benoit, CFA: And people are saying, what’s the budget of your research center? Who’s funding it? Are you on a secret mission or something?

Ashby Monk: We are on a secret mission.

James Benoit, CFA: You don’t have to disclose.

Ashby Monk: Yeah, it’s all on the website. We are funded by Australian Super, New Zealand Super Fund, APG. We were funded by Alaska Permanent Fund. And I’m blanking on… QIC, Queensland Investment Corporation. It’s sovereign funds and pension funds. Oh, San Bernardino.

Basically, the people that we have funding us are long-term investors that are kind of fed up with the status quo. And that’s why I said in the beginning, when I say “we,” I truly think that’s my constituency. If there’s something written on my gravestone — and it will probably take until that time — it’s “Fixed this insane pension industry that is completely dysfunctional.” It’s getting less dysfunctional, but there’s so far to go — so far to go.

And by the way, let me leave you with this little anecdote — people think, oh, people who work at pension funds, they could never do what I do. Literally, I have managers tell me that. They can’t do what I do. They can’t do it. I mean, it’s like, the audacity.
Research just came out that showed the pedigree and the DNA of hedge fund managers — maybe you've seen this research. And it showed, all right, let’s say your DNA is Goldman Sachs, or let’s say your DNA is this. How do you perform in the future? They showed that hedge fund employees that worked at a pension fund produced twice as much alpha as the mean.

So there are people working at pension funds who are brilliant, who are doing the right thing. We are not retaining them. We've got open roles in New York and Boston, because they're trying to pay these people 90 grand a year to live in places — I mean, the arbitrage between the private — I’m going to go nuts. So just try to fix the space.

**James Benoit, CFA:** Fantastic.

**Ashby Monk:** Yeah, man.

**James Benoit, CFA:** We appreciate that. I appreciate your time. It was a fantastic session.

**Ashby Monk:** Thank you very much.