JAKE SIEWERT

This is Exchanges at Goldman Sachs where we discuss developments currently shaping markets, industries and the global economy. I'm Jake Siewert, Global Head of Corporate Communications here at the firm.

Today we're talking about the future of finance, a big topic, and what Wall Street and Silicon Valley have to learn from each other. Our guest is none other than Marty Chavez, Global Co-Head of the Securities Division. Marty, welcome to the program.

MARTY CHAVEZ

Thank you, Jake.

JAKE SIEWERT

Or welcome back to the program, as it were. So, let's get right into it. What's the future of financial services, looking ahead say ten years?

MARTY CHAVEZ

So, one thing I would caveat and say just for starters, that I have unbelievably sharp and precise visions of the future and terrible timing, so I'll say this is the future state of finance, but as far does finance look like this five years from now, ten years from now, 15, 20, I'm not going to say too much about the timeframe, but it's really clear where it's going. So, we've all grown up with traditional categories, usually dichotomies in the financial ecosystem.

So here's one: buy side and sell side. Another one might be market infrastructure providers such as the exchanges in clearinghouses and then everybody who uses the market infrastructure, so providers and users. We could say the same thing about market data. There are companies that sell it and companies that buy it. And that's how we've always thought about those things.

Now, if you look inside financial services firm, you'll find that there has traditionally been a relatively small number of roles that we talk about, so there'd be bankers, salespeople and traders. Now, all of those simple, easy categories are going away and they're going away fast and it's becoming much more complicated and much more multidimensional. So, you can't just say, well, we're a sell side firm and the buy side is our clients and other sell side firms are our competitors.

It actually has always been much more complicated than that. The big systemically important banks have asset management arms generally and the biggest liquidity providers to those asset management arms will be the securities divisions of their archrivals, so we've all been doing this for a long time. There's always been a dependency on the custodian banks, on

banks that provide payment services, transaction services of various kinds, so it hasn't been this strictly, you're our client or you're our competitor for a long time, but it's becoming much more complicated.

And so, I would say all the traditional notions of you're my competitor are giving away to something that looks much more like coopetition, maybe not my favorite word, but you compete in some areas and you cooperate in some other areas and some other areas you might be a client, or they might be a client.

JAKE SIEWERT

So, talk about it specifically in like the market data space, right?

MARTY CHAVEZ

Yeah.

JAKE SIEWERT

In the past, banks were buyers or sell side ...

MARTY CHAVEZ

Yes.

JAKE SIEWERT

... firms were buyers of market data, but they also generated a lot of data. So, how might that evolve over time?

MARTY CHAVEZ

Yes, well, that's a perfect example, right? So, the notion that there are some firms that are in the business of selling data and everybody else buys it, that's changing right now and so financial services firms have become keenly aware that there are vast amounts of data.

Now, this data is something that you have to be exquisitely careful with. The standard of care is like the standard of care for medical records, right? The data might belong to your clients, or it might belong to you or it might be something that you share, but in any case, you have to protect it and

just anonymizing it isn't enough, the standard of what you do with that data. Now, you safeguard it in appropriate ways to generate derive datasets from it and analytics from it is a really complicated topic but is definitely becoming the case that essentially everybody is in the data creation business and potentially the data provision basis.

And so, how I would think about the future state of the financial system is follows to make a simple way of navigating this complex, multidimensional space I would say to every firm and certainly to all the firms in the financial ecosystem, where do you wish to be, do you aspire to be or must you be the best provider of some service and then focus your business on that.

Be top three in the provision of that service and then look at all the other services that you're probably doing inhouse right now because we've

always done it that way and you didn't have any other options for a long time and have a hard look at them and say, that's not our business. We do not want to be providing those services and we don't want to be providing them, even to ourselves because the scale economics, if we're doing it inhouse and there's one customer, which is us, and so there you're going to want to become an astute consumer of services that are provide by others, and you're going to want to have choices, and you're going to have service level agreements.

So really where we see all this going is what a computer scientist would call a big refactoring of all the assets in the financial system, all the participants, which have traditionally been vertically integrated into monoliths and to siloes where you did front, middle and back office because you didn't have any other choices and now it's going to be much more about application programming

interfaces, which define exactly how you produce a service and how you consume a service together with service level agreements. So, the whole thing is reorganizing itself around these API boundaries.

JAKE SIEWERT

So, talk a little bit about, you know, some markets are further along to digitization and others have sort of resisted over time, so ...

MARTY CHAVEZ

Mm-hm.

JAKE SIEWERT

... so which markets will be the hardest to bring along, which markets are further ahead in this transformation that you're seeing?

MARTY CHAVEZ

So, often you'll hear people say the markets that electronify or that will electronify are the ones that have exchanges or that have some kind of central limit order book.

And while that certainly seems sensible because we're used to thinking about equities market structure, particularly in the US and in Europe and in Asia as one that's centered on exchanges and we know that there is low latency trading and we know that there is electronic order books and it's well understood that equities, has electronified or at least that's one way to frame it, but it is not accurate to say that the electronification of a market depends on whether that market has an exchange market structure.

Actually, the key is whether the workflow is electronic and whether the workflow is digitized, and it's digitized at the right level of abstraction. By that I mean if the workflow in a particular business consists of human beings talking to each other over the phone, well, you could say it's digitized in the trivial sense that we know the telephone conversations are all ultimately digital signals, but

the digitization isn't happening at the level of the

conversation and so in those markets where it

consists of people talking to each other on the

phone, all of the data, all of the workflow is actually

just dissipating out into the atmosphere, right? You

say the words and ...

JAKE SIEWERT

It sounds like my job. Yeah.

MARTY CHAVEZ

(Laughs)

JAKE SIEWERT

Everything is dissipation. (Laughs)

MARTY CHAVEZ

Very good, the instant you say it. On the other

hand, when the information is captured in tools and

in systems and in platforms and that, of course, is

more likely to happen when there's exchanges but

does not require exchanges, so when the workflow

is there in a digital form, then you're able to

analyze the workflow, and you're able to streamline

it, and you're able to infer data structures and derive datasets from it and that's what starts the whole flywheel of electronifying a market.

And so I would look at the markets where the entire market structure, the entire exchange of transfer of risk is happening by phone today. Those are going to be the last markets to become electronic, but even there, as we, and our clients and our competitors have been introducing systems that help people do their jobs more effectively, those systems are starting to capture the data and now you have the workflow and a form where machines can analyze it and can process it, and the machines can start talking to each other through APIs, and once that starts going, you can find a market become electronified very rapidly. Case and point would be the foreign exchange market. Yes, there are exchanges in that market, it isn't really an exchange market structure and yet it's 99

percent electronic.

Even when we look at a particular market such as the foreign exchange market and say it's mostly electronic, they were really talking about spot foreign exchange transactions. That is nearly 100 percent electronic, but as soon as you get into forwards and options, it's a lot less electronic. Same thing with equities. We're used to thinking of cash equities in round lots as being heavily electronic, but as soon as you get into customized equity derivatives and very large size, not 100 shares, those things are much less electronic today.

JAKE SIEWERT

So, we've seen other industries where machines have sort of taken over. I mean, agriculture used to be a major employer, now not so much and yet we still have high productivity in the agricultural sector.

MARTY CHAVEZ

Yes.

JAKE SIEWERT

Manufacturing, similarly, used to employ lots of people. Factories now tend to be much more robots and machines, fewer people and yet you still produce millions and millions of cars and widgets a year. How about the trading floor? What will the need for human labor look like in the future as the trading floor becomes more electronified and machines do more of the talking to each other?

JAKE SIEWERT

So, interestingly, and this might be a counterintuitive notion, we find that over time, the number of people working on a business, when you look at all the people working on a business, through the front, the middle and the back office, number of people stays relatively stable over large periods of time.

Here's what changes; the volume of business goes up dramatically, exponentially, right? And the structure of the business can change. So, for instance, in the equities markets over the last ten years since the crisis, over the last 20 years, this has been true, the number of people overall working on the business has been relatively stable. Commissions have gone down to a tiny fraction of what they used to be 20 years ago. The volumes are much greater, and the products and services are completely different, so commissions are still important, but there are many other businesses that are as or even more important than the commission basis.

And what's also happened is if you look at the people working on the business, they're doing a much heavily volume, as I mentioned, the skillsets of that group of people and the functional roles and the activities of those people have changed very

dramatically. And so, if you look at any role in any business, including the financial services business that consists of manual processing, that consists of talking on the phone, typing a number, maybe cutting and pasting it into a spreadsheet, reading that number over the phone, all of those workflows are going away.

Now, I would submit that that's not really exciting work, right, and having people who are ...

JAKE SIEWERT

It doesn't engage your brain.

MARTY CHAVEZ

... it doesn't engage in your brain in having very beautifully educated people working on that because that's the way we've always done it. To me, that makes no more sense than if I were to compete with my calculator to see who can multiply ten-digit numbers faster. The calculator is going to win, it's going to be more reliable and I don't set

myself up as a competitor to the calculator in that game, I would just say, okay, calculator, you win. You do that and I'm going to go on and do something else.

And I think this is true of all of us in the business. If I look at many of the roles that I've had in the past and ask where are they now, well, the role just doesn't happen now. Some of the jobs I've had in the past still exist, but there are many of them that have just gone away and I'm still here and I'm doing sort of the same thing that I've always been doing, which is solving hard problems with math and software and the kinds of problems, and the scale of the problems, and the complexity of the problems has changed enormously, but the basic activity has stayed the same over a very long period of time.

JAKE SIEWERT

So, the last time you were on the podcast, you

were a big proponent of open software ...

MARTY CHAVEZ

Yes.

JAKE SIEWERT

... in finance and saying it was ...

MARTY CHAVEZ

Yes.

JAKE SIEWERT

 ... an industry that had undervalued open software

in the past.

MARTY CHAVEZ

Mm-hm.

JAKE SIEWERT

So, you mentioned APIs earlier. Talk a little bit

about what are APIs and how we're using them

here at Goldman.

MARTY CHAVEZ

So, if I look at some of the fundamental shifts in

technology that have driven huge changes in our

reality and huge creations and new value chains, I

would say open software, cloud services and APIs are definitively the creators of the transformation that we've all seen in our industry and in many other industries in the last few years.

Now, I would say at Goldman Sachs for a long time, and I might have even mentioned this on the last podcast, we used to have this wonderful little mantra, "The only thing crazier than writing all your own software is not writing all your own software", and we used to pride ourselves on that. We used to say (Laughs) ...

JAKE SIEWERT

Everything was homegrown, right?

MARTY CHAVEZ

Everything was homegrown. And looking back, we actually just ... it's a very engineer kind of thing to do ... we actually just had a birthday party for a piece of software that we've been working on for (Laughs) 25 year and, of course, we had a lot of

pizza that we ordered out for the party because that's what we do.

And when I look back on that, I think we invented some really amazing things back in the late '80s and early '90s, like things that everybody would now call a platform, things that people now would call no sequel, our own programming language which we invented because Java and Python didn't exist, and we needed to create it. And when I look back on that, I don't regret any of it. They were great choices at the time.

But the world has changed, and we've changed, as well, and now when we look at building software, we think, well, first, can we download it for free from some open source community and participate and give back to that open source community to make the software better, that's our first move and if we're certain that that's not going to work, then

the backup position is we're going to buy it and

there we greatly prefer to buy software as a service

and there we want to know what the application

programming interface, the API is, and we care a

lot. Is it going to be backwards compatible, is it

well designed, is it bulletproof, is it flexible, is it

simple, is it impeccably defined in the

documentation? We care a lot about the service

level agreements, and we want there to be

choices.

We want there to be an open API and we want to

have a lot of companies that are producing that API

so that we have choices about how to consume it.

So, that's what we do after we convinced ourselves

that open software isn't going to work. And then

the last thing that we're going to do, and we're

going to do it if it's mission critical to us and

differentiating from us and the first two don't work,

which is all wrapped up with being mission critical

and differentiating, then we're actually going to go build it.

And so, this reconfiguration, the way we build software, the way everybody builds software around am I the best producer of some API or am I an astute consumer of an API is a powerful notion.

JAKE SIEWERT

So, how does that open software dynamic change the relationship you have with clients?

MARTY CHAVEZ

Well, it's certainly changed in that now we're having conversations with clients where we will say, well, here's something software that's on GitHub and it shows you how you can use our APIs, it gives you a lot of sample code and a lot of documentation, a lot of libraries that you can plug into your favorite platform, your favorite frameworks and then here's our API.

And actually, we would think of it as a compliment and a sign of success if our clients go to our competitors and say, we really love that Goldman API, we've built our platform on top of it and if you want to provide us your services, we're happy to have multiple suppliers and we want you to provide the services to that Goldman API, to that Goldman spec, right? The spec, as far as we're concerned, for the API, belongs to the planet, and it's fantastic, and it's good for everybody, it's also good for us if it becomes a standard.

But we're not holding onto it. We're seeing that API layer(?) has opened, now here's the important point, and you might see some articles, that confuse open source with APIs, right? And so, you might have seen some articles that talked about how we're open sourcing SecDB. SecDB is this platform that we've been building ...

JAKE SIEWERT

The platform you built, yeah, yeah.

MARTY CHAVEZ

... for 25 years that we had the birthday party for and while that might be one way to frame it, it's certainly not the way I would frame it, right? (Laughs) Like SecDB continues to be this engine that we've invested heavily in and continue to invest in and we're not taking the source code for SecDB and putting that on GitHub, but instead, SecDB becomes this engine, this platform that our clients can get the value of by asking it questions and it gives back answers and that's done through the API and all the ways that you can incorporate these SecDB information and risk exchanges into your business are given to you as examples and that is open software. But all the stuff under the hood is not.

JAKE SIEWERT

So, your background, and you referred to it as in computer science.

MARTY CHAVEZ

Yes.

JAKE SIEWERT

You studied at Stanford. How's the role of computer science in financial services changed over the course of your career? I mean, we could probably spend hours on that, but ...

MARTY CHAVEZ

(Laughs)

JAKE SIEWERT

... give us the short form.

MARTY CHAVEZ

Well, I like to tell stories and so here's one story. So, I came out of Stanford, as you said, and out of a Silicon Valley startup and how did I get to Goldman Sachs? I love the story.

I had never considered, it never even entered my mind a career in finance, but the gentleman who hired me, is still our partner here, told the

headhunter, I want you to make a list of entrepreneurs in Silicon Valley with PhDs from Stanford in math, physics or computer science and ship them in for an interview. And so, I thought I was getting a free trip to New York, I was going to see some Broadway shows, have some fun (Laughs) and ...

JAKE SIEWERT

Here you are.

(LAUGHTER)

MARTY CHAVEZ

... 26 years later and so I would put that under the category of I was in the right place at the right time with the right preparation, but I had no idea what I was preparing for and so it's a story of serendipity.

But then I got here and one of the first things I found myself doing was getting phone calls from Tokyo or Hong Kong at 2 in the morning and I'd get dressed, and I'd hail a cab, and I'd go downtown

and I'd reboot some machines that had somehow

(Laughs) managed to stop working during the night

and ...

JAKE SIEWERT

Sounds very glamorous.

(LAUGHTER)

MARTY CHAVEZ

... as they were running some of our risk

calculations and I did think my whole life has

brought me to this, and I was wondering if that PhD

was really worth it. And so, there was an awful lot

of that.

And certainly one of the things that I've done really

pretty much my whole life is I'm a math and

software geek, and so I lead with that and so I

would do math for the popular kids in my class

and I found myself on Wall Street doing math for

the traders. And so, it was kind of the same idea.

(Laughs) And so, in a perverse way, it felt very

comfortable. But it certainly also felt like a service, right, and like I'm here to do the math and just stay doing that. And that has certainly changed in a really dramatic way over the years.

So, when I joined this team ... we call them "strategists" or "strats", but the world has settled on the term "data scientist", right, so people with the math and software skillset doing some quantitative problem solving, I was number 12 in that group and now that group has joined together with the much larger technology division to be our engineering organization and now it's roughly 25 to 30 percent of the firm and it's order of 10,000 people and so ...

JAKE SIEWERT

Depending on definitions.

MARTY CHAVEZ

Yeah.

JAKE SIEWERT

Roughly, yeah.

MARTY CHAVEZ

Rough numbers.

JAKE SIEWERT

Yeah.

MARTY CHAVEZ

It's essentially that. And now we have engineers in one of them, but there are many who are in leadership positions in our businesses and we've also found over time that ... and this goes back to something I said at the outset ... the traditional roles like trader, bankers, sales, are becoming much more complicated, and I'll give you one example.

About three years ago, we introduced working with our stakeholders and our regulators, a role called "traders who code" and we thought of many other ways of describing it. One of them would have been "engineers who trade". (Laughs) But trader has a very specific regulatory construct and here's

an evolution that has absolutely happened and we've recognized it and the industry has recognized it.

A long time ago we used to say traders commit capital and the strats or the engineers do not. Strats or engineers write code, build models, the traders do not, and they're not allowed to, and that strict dichotomy worked really well for a long time, but then as markets electronified, as the workflows became digitally captured, then it suddenly was not obvious who is committing the capital because the strats, writing some software and the software is putting an order into the exchange and so it was really clear that you needed people with both skillsets, the idea that you could separate the skillsets into two different human beings were no longer tenable. And so, that's another way in which the role of engineer, the world computer scientist on Wall Street has changed.

We're seeing the same thing start to happen in other roles, too, and so bankers who code, and salespeople who code and compliance professionals who code and lawyers who code. And to my mind, coding, it's a bit like writing an English sentence. It's something that's useful to know how to do, it's useful to have that mindset, algorithmic problem solving, and you might be spending your days writing lots of code, just like you might be spending your days writing lots of English sentences, or it might be a tool that you use in the services of some other job and that's happening everywhere.

JAKE SIEWERT

So, as you look around the industry and listen to others who are thoughtful about this, what are some of the other views that you're hearing about the future of finance and what are others predicting?

MARTY CHAVEZ

Well, here's one view that I hear in my travels and I'm sure you heard it, too, which is the fintech disruptors, they're going to come in and they're going to disrupt those banks. And, well, I would not recommend to anybody the strategy of just assuming that these big, lumbering banks are incapable of making great software and therefore they will fade away into oblivion, nor would I recommend to anybody the strategy of, well, I'm calling myself a fintech and therefore I don't have to comply with the banking or the money transfer regulations because I'm a technology firm. That strategy I can't recommend, either.

JAKE SIEWERT

It's not going to fly in Washington?

MARTY CHAVEZ

No, it is certainly not. And so, what I would say is that, back to what I was saying earlier about traders who code, right, coding is something that

everybody has to get really good at and banks have to get really good at it and have gotten good at it.

And so, again, we'd be talking in our own book here about something that we've done at Goldman Sachs, but if you look at our consumer finance business, the Marcus business, from the day we wrote the first line of code to the day we made our first production loan to a consumer, a retail consumer, that elapsed period of time was 11 months. And to do something that's production quality in an institution that's been around for almost 150 years, 150 years now and to do it at the scale that the US regulators require for know your client, anti-money laundering capital, everything else, and to do that in 11 months and writing really less than a million lines of code, I think that one example speaks to a lot of things.

First of all, when banks who have invested heavily in making banks a great place for engineers to build their careers set their minds to doing something, a bank can do something of very high quality in a very short time just as fast as any startup, and they can do it at scale and they'll be doing it in the ways we described, by combining together APIs and services provided by others, some of them are open source, some of them are commercial services and that has become the way of the world.

So, the way I would see this all developing is back to something we said earlier, I said the old dichotomies are giving away to every firm is producing some services and consuming other services and the services are defined by APIs. There will be, I would predict, companies inside a particular regulatory boundary and they will be providing services by API to companies that are

outside the regulatory boundary.

JAKE SIEWERT

So, you spent some time, obviously, over the course of your career in Silicon Valley. What could Wall Street learn from Silicon Valley in terms of how it innovates, and how it thinks about coding and on the flip side, what's the most important thing that Silicon Valley could learn from Wall Street?

MARTY CHAVEZ

So, when I look at a huge and powerful trend in the world, I think there's an awful lot that banks can learn from cloud services and maybe not in the way that you would initially expect banks can learn from cloud services.

So, the first learning is something that goes back a few years. I remember when we here at Goldman Sachs became consumers at scale of cloud services that were produced by others. And the conversation with our peer group in those days,

and now I'm talking about five, six, seven years back, was we won't use cloud services because regulation. Well, that was never a syllogism, right, it was more of an excuse.

And so something that has happened, and this is something that we were in the vanguard of and it's now happened everywhere is every financial services firm is consuming cloud services, so the cloud services got better, we and others worked with the cloud service providers to modify and evolve them so that they could work in our regulated environment with our requirements in use cases and so now everybody is using cloud services. So, that's the first learning.

The second learning, potentially even more powerful, and we're in the very early days of this, if you look at one of the leading cloud service providers, which of course would be Amazon, well,

how did they come onto the idea of Amazon Web Services in the first place?

Well, with any fantastically successful business, there will be a variety of creation stories and one of the creation stories, I wasn't at Amazon, but here's one, which is Amazon looked at its business and said, well, we have this vast capability that we've had to develop so that we can build our website that has products and gets the merchandise to consumers. We've had to build these complex capabilities for computation and data storage. And back to something I mentioned earlier, it doesn't make sense for us to be the only consumer of our data and compute capabilities, so let's put an API around it, it's be really strict about that API encapsulation. You don't get to violate the API. If you want some data and compute services, you don't pick up the phone and call somebody, you call the API and then once you do that, you start

thinking, well, let's provide those services to everybody.

Well, the thing that's happening now, and you're seeing in this many industries and you're certainly seeing it in our industries, is a lot of introspection where companies are looking at the capabilities that they've got inhouse and they're saying, we're not so sure that it makes sense for us to be the best producer of this capability or service if we're the only consumer, but there might actually be a business here if we externalize it and we produce that service for ourselves and we produce it for a lot of other people who we might have seen as our clients or we might have seen as our competitors traditionally.

And so, looking inside your business and finding the things you want to produce, the things you want to produce for everybody, the things that

you're currently producing just for yourself that

you ought to be producing for a much wider

universe and then ultimately the things that you just

want to buy in from others.

JAKE SIEWERT

And on the flip side, what could the Valley learn ...

this is not even a question we would have asked

five or six years ago ... but what could the Valley

learn from the financial services industry?

MARTY CHAVEZ

Well, certainly there's a lot to learn, but here is one;

since the financial crisis, there's been a profound

lesson learned in financial services that the

regulators are important, hugely important, critical

stakeholders and collaborating with the regulators,

being deeply transparent with them, providing them

services so that they can do their jobs better,

recognizing that making the whole system safer

and sounder is better for everybody, even though

in the short-term it might seem complicated and

expensive, gets to a better long-term systemic result and partnering with the regulators to get that done is something that I would say, well, the regulators deserve several victory laps here for having effected great change in the system and I would also say the banks have completely changed themselves.

So, for instance, the regulators have greatly upgraded all the bank's capabilities to understand and model their own risk, their cashflow, their income statement, their balance sheet out into the future to demonstrate that they have sufficient capital. That's something that's worked really well and here we are past the financial crisis and things have been relatively stable for a long time.

So, I think that lesson of how to engage the regulators to get to a better result systemically as opposed to just maybe saying, well, our business

hasn't been regulated and we're going to, our strategy is going to be predicated on it not being regulated. I would say here's a simple way to think about regulation; if it's interesting, it will be regulated. If it's not interesting, it won't be regulated and any other state is just a transient(?) state on the way from one to the other.

JAKE SIEWERT

Now, you can argue the regulation of the banking system, especially in the US because it was done so quickly and forcefully, has actually made the banks much more competitive, too, ironically ...

MARTY CHAVEZ

Absolutely.

JAKE SIEWERT

... versus the European banks where the regulation has been a little bit slower to take hold and more complicated, frankly, because of the governance there.

MARTY CHAVEZ

It's fragmented. There are a bunch of reasons it didn't evolve the same way, but certainly in the US the banks took their (Inaudible) and have much more liquidity and much more capital and it's a completely different set up and it's more stable on the other side of that. I think there's that, that would be something that I would encourage my friends and colleagues in Silicon Valley to look at that pattern and find what the analogy would be for technology as we start thinking very seriously about data privacy and the systemic importance of the technology firms, what it might look like.

JAKE SIEWERT

So, we'd be remiss if we went a whole podcast without talking about blockchain at the very least. So, what will keep it simple? Of these three; blockchain, artificial intelligence and quantum computing, which are most excited about and why?

MARTY CHAVEZ

So, for me, I would put at the top of my list artificial

intelligence. Now, for me to put it at the top of the list, and even to say the word, "artificial intelligence", there's a little mini story in there.

So, I was working in one of the AI labs at Stanford, it's called the Knowledge Systems Laboratory, back in the day when I was a graduate student, and back in the middle '90s to ... sorry, middle '80s to early '90s when I was working on this with many other people, we were getting despondent about AI. In fact, we were starting to get embarrassed by even using the word "artificial intelligence" because the goals that we had set for ourselves, the dreams that we had were receding rapidly into the future (Laughs) and it was very clear that with the techniques that we had, and the computers that we had and the data stores that we had, we were only able to solve toy problems.

Now, years later, I still randomly get emails from

the Internet and they take the form, I read your

PhD dissertation 1990, which I always (Laughs)

have a moment of panic when I read that, certainly

reminding myself that I have not read it since I

submitted it (Laughs) and so somebody is reading

it. And then they'll go on to say, and I've

implemented the algorithms and the algorithms

work really well, which is a major relief and ...

JAKE SIEWERT

But with a bigger dataset.

MARTY CHAVEZ

Well, that's it. And so, if you look ... I mean, there

have been huge a huge amount of creativity and

breakthroughs, absolutely, but without the power of

Moore's law, making huge data stores and very

fast machines, it wouldn't work. You needed the

trifecta of the techniques that had been around for

a long time, plus new techniques and then rapid

evolution and machine speeds and then data

stores. And when all that came together, you were

able to do things that seemed intractable before.

So, now we're at the stage, which is an amazing place to be, if you can take a problem and describe it in the following way; here are a billion training examples of the problem and somehow by hook or by crook, maybe a bunch of human beings, who knows, they've been categorized into two groups, this is set A, and this is set B. So, my favorite example, the Internet has helped us build a database of billions of pictures of cats. For some reason, human beings like posting (Laughs) pictures of ...

JAKE SIEWERT

They like to share cats.

(LAUGHTER)

MARTY CHAVEZ

... they like to share cats and then as they share them, they'll mention the word "cat". And so, it's pretty easy to see this association between image

and the word "cat" and then there's lots of other images that nobody mentions cat in and around and we can assume those don't have cats and so now we've got this incredible database of a billion images, five hundred million of them are cats and five hundred million of them are not.

We can just crank that into machine learning algorithms that are now standard, and we have something that will now take a new image that no one's ever seen before and it will do an amazing job of telling you whether there's a cat in it. Now, that might sound kind of silly, but as it happens, there's a large number of really important problems that you can frame that way. Does this scanning electron micrograph have a picture of cancerous cells or not? Well, if you've had trained pathologists categorize or label a large number of images, in their professional judgement and training, it has cancer, it doesn't have cancer, well,

now you can have machine learning techniques do amazing things.

Now, what would be really exciting and what is the dream is how are we going to get from where we are now, which is an amazing place, which has unlocked machine translation and all kinds of things that have been dreams for a long time, how do we get from there to general artificial intelligence and that's the area where I just don't know. I am not personally aware of the techniques that are out there today that just need computers to get faster and then we'll have automated general intelligence.

My view, and there's a variety of views on this, is that we're going to require some great breakthrough in the techniques. But the amount of investment and the amount of academic research that's going into this area is staggering. We've

already seen the results that we can achieve with this relatively limited concept of machine learning when we've already got the problems categorized.

Now, how can we leap into the more complicated world where the distribution is not stationary, we don't have all the instances of the problem pre-labeled as this is a cat, this is not a cat. Like how are we going to solve that? That's a huge and interesting problem and there will be all kinds of transformations on the other side.

I would put shortly after that quantum computing. I and many others have been a skeptic, but more recently as I've seen, what some of the quantum hardware companies and software companies are actually producing, you know, it's super hard. I think the notion that we're going to have some magical new kind of computer that's a quantum computer and it can do everything faster, I don't

really see that happening. I actually don't see that happening in our lifetimes.

But taking very specific and very important problems, they could be problems in the life sciences, they could be problems in finance, they could be chemical and physical simulations of various kinds, and framing them as a quantum experiment, which can be done in a chip, which would then be joined with the general-purpose computer, I think there's a huge amount of investment going on there and there's going to be some huge breakthroughs there.

So, I would put blockchain last. Now, I spent a lot of time thinking about blockchain over the years and here's something that is exciting to me, being a computer scientist, it's a particularly interesting solution to a problem that's been around in computer science since the 1980s. It's called the

Byzantine General's Problem. You've got a bunch of generals, a raid on the field, some of them are loyal, some of them are not.

Communication on the battlefield is noisy. In the face of all of that, how do you get the loyal generals to agree on the battle plan? And blockchain, the bitcoin blockchain is actually a solution for exactly that problem. You have a lot of people who might be running the correct protocol, they might not be. How do we all reach agreement on which blocks are legitimate parts of the blockchain?

Now, the skeptic in me would say, a blockchain is a particular kind of distributed database that solves the Byzantine General's Problem. Distributed databases are notoriously difficult to manage, and maintain and build. And the other question you ask is, is Byzantine security, that level of security of with that level of noise and unreliability, is that

really what's needed for most real-world problems or is it overkill? And so, I think there is some hype component, like let's do everything on the blockchain, reminds me a little bit of the early days of the Internet. Let's do pet food on the Internet, you know, every possible thing on the Internet. So, I think we were going through that iteration.

And then on the other side, there's a lot that you can imagine being done and needing doing in the financial system when it comes to payments and when it comes to stores of value. There's a lot of the payment rails and the records that are still relatively antiquated. You know, some kind of a blockchain going to be part of the solution, it is possible, it's a work in progress, why are we and other working on it? Because what you would get if that exists is really valuable.

Right now, an important problem in finance is we

might agree to trade a security, but it usually takes two business days for the security and the cash to change hands. That's the settlement cycle. And we've learned that having the execution cycle happen on the order of a microsecond or even nanoseconds and then having the sediment cycle take two business days, that's really, really slow and ...

JAKE SIEWERT

And risky.

MARTY CHAVEZ

... and risky, exactly.

JAKE SIEWERT

Yeah.

MARTY CHAVEZ

There's so many things that can go wrong while you're executing all those trades, but you haven't actually seen the cash come out of your bank account and it's not going to come out for two days, right? It can take a while to wake up to

problems. And so, bringing those more into alignment, I don't think you want instantaneous execution in clearing a settlement of every transaction, I think you want the execution to happen rapidly and then you want a bunch of transactions to accumulate over a small settlement window and then you settle those.

But if you could do that more rapidly, if you could do that in the order of seconds or minutes because you've digitized the assets and the assets are represented natively in a digital form, not in some kind of paper certificate that's been scanned or stored somewhere, but their original existence is as a token on a blockchain and then if you could have a unitive value that had the full faith and credit of government behind it and that that was also natively digitized, and you could deliver versus payment with those two digital assets, that would be something that greatly increases systemic

safety and soundness.

So, it's still out there, it's important, there's a lot of work happening on it. Will the eventual answer incorporate elements of blockchain? I would say that's likely and it's a work in progress.

JAKE SIEWERT

So, finally, just to wrap up, we talked a little bit about your career, your computer science background, how you ended up in finance. You were also an entrepreneur for a bit. Talk a little bit about that and how you ended up back at Goldman and what you learned from starting a business that translates to the way you do your job now.

MARTY CHAVEZ

So, in my last startup, I would put this under the category of having a great idea, a clear vision of the future and terrible timing. The idea was software as a service, give us your trades and we'll

give you your risk. And, well, we had the idea at a time way before software as a service is a term or a concept existed and way before all the enabling software, the middleware and the cloud services existed and so it was a different economic proposition then when we had to spend ...

JAKE SIEWERT

More expensive to build, yeah.

MARTY CHAVEZ

... so much capital just on the switches, and the routers, and the database licenses and all of that, whereas now you just pay as you go to your cloud service providers and they scale as you scale, and everybody is happy. So, that was a very different time. Here are a couple lessons that I took out of that experience, which was brutal and wonderful.

One lesson was you only have a sale of your product or service if you've convinced your prospective client that they have an unbearable

pain, or burden or problem and you alone have the solution to it. And then they will pay money for that service, right? So, that sounds obvious, maybe, but in the hype of the dot com boom, that core principle, whose problem are we really solving such that they will pay real cash money for, for that service, that kind of got forgotten and so when all the hype boiled away, the only companies that survived were the ones who remembered that. So, that's one thing.

The other thing I learned is when you're building software on a tight budget because you've raised some money from your investors and the dot com bubble has burst and there's no possibility of raising more money from those investors, so you've got what you've got, and you've got to build the software that solves the problem that the real customers pay money for in a limited amount of time.

The only way to do that is to have extreme clarity about what are we building, why are we building it, who is the primary client for whom we change our design to ensure that they're satisfied, who is the team leader who is accountable, who are the people on the team, what are the binary measures of success and has everyone on the team committed to the success of the project and given up their right to complain? (Laughs)

So, that framework for building software was what allowed the company that I and some of my colleagues had started, to survive. And that focus on what's valuable to the client, not what we think is valuable. And so, I learned that. I was completely fried by the time we sold the company ...

JAKE SIEWERT

(Laughs)

MARTY CHAVEZ

... and I went to the beach and I just sat there staring at the ocean for a few months. (Laughs) And in the middle of that, Gary Cohn, who was Head of the Securities Division at the time, later President of Goldman Sachs, called me up and he said, Marty, I heard you sold your company, congratulations. I heard you retired. That's ridiculous.

(LAUGHTER)

MARTY CHAVEZ

And I'm calling to share with you that you're coming back to Goldman Sachs. (Laughs) And so, those of us who know Gary know that that's the kind of approach that he would take to the ...

JAKE SIEWERT

Very direct.

MARTY CHAVEZ

... take to this, very direct. (Laughs) And so, he said, we really miss you in the commodities

business and I said, I'm really burned out on commodities. I'd consider anything but commodities. And he said, how about banking? And I said, well, I guess I need to remind you that I don't know anything about banking. And he said, great. (Laughs) And so the idea was put someone who was a derivatives strategist in banking and maybe somebody interesting will happen.

The really interesting thing that happens is I brought that startup experience, those two lessons I learned into the great, vastly bigger enterprise of Goldman Sachs. And that idea that we're here to serve our clients and that's the reason we're here and there is no other reason that we're here. And then, also, how to build software that meets the project specifications that are well defined and unambiguous and does it on time and doing it at an institutional scale, like being able to impart that and share that, not just with ten or twenty engineers,

but with ten thousand engineers has been an amazing experience.

JAKE SIEWERT

Well, Marty, thanks for joining us today.

MARTY CHAVEZ

Thank you, Jake, always a pleasure.

JAKE SIEWERT

That concludes this episode of Exchanges at Goldman Sachs. Thanks for listening and if you enjoyed the show, we hope you subscribe at Apple podcasts and leave a rating or a comment.

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