Deloitte TECHTalks | EPISODE 23 | Quantum in Finance
With [Mekena McGrew](), Quantum Information Lead, Deloitte Consulting LLP

Raquel Buscaino: Welcome to Deloitte TECHTalks. I'm your host, Raquel Buscaino and I lead Deloitte's novel and exponential technologies team where we sense and make sense of emerging tech. I'm very excited to discuss today's tech topic, "quantum computing". For those who've been tuning into tech talks for a while now, you might remember that last season, we had a full episode dedicated to Quantum. Today's episode, however, is going to take us one step further, as we'll be talking about the real near-term commercial applications of quantum in the financial services industry. So, for those of you asking the question, how could my company use quantum technology today? By the end of the episode, I think you'll likely have your answer.

I'm thrilled to be joined on today's episode by Mekena McGrew, Quantum Information Lead with Deloitte Consulting LLP who focuses on quantum applications within the financial services industry. Mekena, it's so good to have you, welcome to the podcast.

Mekena McGrew: Thanks for having me, Raquel.

Raquel Buscaino: It'll be a fun conversation today. You know, we've been hearing about quantum for over a decade, and often I think it's remained quite theoretical in nature, but recently it seems that the narrative has shifted more towards the practical applications of quantum. So, as we kick off our episode on all things quantum here, maybe you could help our listeners and myself even, better understand what's available today and what's yet to come when it comes to quantum?

Mekena McGrew: Thanks Raquel. I kind of want to start like a little historical context around why scientists have been so interested in quantum technology and computer scientists as well. So, there were several algorithms that came out in the last, probably 30 years. They were mathematical formulations that were able to show interesting speed-ups that you could get using some future device known as a quantum computer.

So, these algorithms, one of the most well-known is known as Shor's algorithm, which is an algorithm that can factor prime numbers exponentially faster than any classical computer and this is what you might hear a lot of buzz about in the industry because it renders cybersecurity protocols obsolete. So that's one theoretical algorithm in quantum computing. There are others that have applicability to machine learning and chemistry, one known as Grover's Search, and you can get additional speed ups like quadratic speed ups and even a more recent theoretical paper for optimization that showed an exponential speed up.

However, like you said, these are very theoretical in nature and so that's where the real promise of quantum computing in the future lies. And that's why there's a tremendous amount of investment and effort to get machines that are capable of producing those. But the problem is, the quantum computers today are quite noisy, because it turns out that these quantum computers are not only hard to build, they are very sensitive to the world around them and result in errors. And so, to execute some of these theoretical algorithms, it requires a lot of operations on a quantum computer. And if we were to execute all those operations on the quantum computers of today, all you would get out is noise. And so, a tremendous amount of effort over the last, maybe 6 or 7 years went into these near-term hybrid quantum classical algorithms. Some of them relate to optimization, some relate to machine learning and also chemistry and materials. And so, you'll typically hear about this class of algorithms in the near term.

Raquel Buscaino: Mekena, maybe we could just do the quickest overview. What is noise? And what do we mean when we say error correcting?

Mekena McGrew: Yes. So even in classical computers, you have physical components underneath, right? And this results in different types of error. With quantum, it's a little more sensitive, and there's more special types of protocols to take care of the errors in algorithms. This usually requires more qubits. So, you could think “I have 25 physical qubits in my quantum computer, but I need all 25 of those to make one good error-corrected qubit, one logical qubit”.

And this is where the industry is starting to go, trying to implement what's known as the logical qubit, because when you can stabilize our qubits, the results that we get out are going to be more reliable and accurate, and I think what we're going to see, maybe in the next 3 years, is what we're going to call small logical quantum computers. And I think even with these small logical quantum computers, they're not going to be implementing the great promise of Shor's algorithm or Grover search, however, it will be implementing some of these hybrid quantum classical algorithms that I mentioned before, reliably, at a better scale, starting to access new areas of computation and also getting reliable results out of quantum computers.

Raquel Buscaino: Makes sense and thanks for breaking that down. I think we think about quantum, very generally. I think we think about most technologies in these big bucket terms. It's “blockchain”, or it's “extended reality”. And it's these huge, massive technology groupings and categories, but I think what you've kind of outlined to us a little bit is there's actually the near-term applications, there's longer term applications, and there's a whole spectrum in between. Where do you see as what those early-stage application areas are? Can you give us more insight into what the L2/L3 technology categories within the near-term quantum segment is?

Mekena McGrew: Yes. So, when it comes to quantum applications in Finance, specifically, we can think about what I had mentioned earlier, which is these tensor networks, and something that we call quantum inspired approaches. And when I say tensor networks, I mean an algorithmic linear algebra technique that's used to compress very high dimensional spaces into compact and manageable forms. And this is a very interesting development that has been progressing in tandem with the development of the quantum computing hardware itself.

So, tensor networks have been used in chemistry and physics for a very long time, and I think, as we as a research collaboration started exploring applications for near term quantum computers, we started realizing that there was also applications for these tensor networks. And we can find that these tensor networks have applications as well, similar to the quantum computers, to machine learning, something that I study quite deeply and work on here at Deloitte, optimization, and a really interesting development is the applicability of tensor networks to financial simulation, and going beyond Monte Carlo approaches which is used across the financial services industry and a lot of high value use cases.

Raquel Buscaino: So, if I'm hearing you correctly, these near-term quantum applications are using quantum inspired algorithms or simulations, and that's what you know, tensor networks are being used for today, right? I mean, not just a year or 2 from now or not in the future. But companies are using it today to get the simulation benefits that you just mentioned.

Mekena McGrew: Yes, tensor networks are a "here-and-now" approach. It really just turns out to be software in the end. And so, some of that overhead of trying to think about new architectures, or moving and migrating data to a different cloud provider for instance, or worrying about security associated with a quantum computer that doesn't exist. Right? It's just like "Do I have a really good classical computer that I can execute these algorithms on?" and something that's really interesting is how this relates to accelerated computing."

So, we're actually starting to see more of a migration, not to quantum, which is a little further away but a migration to accelerating compute hardware, specifically being driven by Generative AI, and so, some of these quantum inspired approaches are really good use cases for GPUs (Graphic Processing Units). So, when we think about creating roadmaps for quantum technology and how to start embedding these algorithms into your workflow, you can see that it actually naturally aligns with accelerated computing migration and a preparation for future quantum computing architectures.

Raquel Buscaino: So interesting because Generative AI has been the buzzword of the last 2 years, and I think a lot of times people ask, "well, what are the enabling or complementary technology sets that go along with any tech movement?" And so, really interesting here to hear your perspective because those early near stage application areas of quantum are in the simulation and the software game, there's a lot of synergy between the 2 from a hardware and infrastructure perspective.

Mekena McGrew: Yes, yes, that's very true.

Raquel Buscaino: So okay, let's say that I'm an exec at a big bank right now, what's the realistic timeframe that I'd be looking at, and what would be the things I'd need to do to create commercial value sooner rather than later here?

Mekena McGrew: So, there's a lot to think about when it comes to quantum technology from an executive point of view. A lot of these use cases touch very core business functions within the financial services industry, and in fact, touch the money. So, if you're trying to think about how you can move forward with quantum computing use cases, it's a really good understanding to know what is going to be near-term ROI-driving and what is going to be very future ROI-driving. As I mentioned, quantum inspired approaches are here and now. This is something where you can get your feet wet, explore certain use cases within your organization, and see and quantify the value that these new methods will bring to your business.

Taking a step further, I think we can look into the next horizon, which is beyond quantum-inspired where we start solving more complex problems, where we start seeing the advantages of quantum computers, and this is likely going to be on optimization type problems or machine learning type problems. And we can see optimization is used ubiquitously in Finance, machine learning is gaining greater traction, both traditional machine learning and even thinking about how traditional machine learning and GenAI work together, like in agentic-type modeling, and quantum actually can play a role in this other big strategy that you might have going on.

And then far future, which is these option pricing, derivative pricing. So sometimes banking execs get really excited about speed ups when it comes to derivative pricing, but it's good to know when you're assessing use cases across your organization that that is a far horizon-type use case.

Raquel Buscaino: I love it. I mean one, I love that we withheld saying the word “Agentic AI” until at least the 3rd question that I got into, so that's always a good sign on a podcast. But two, I love the way that you outlined it, from quantum inspired to optimization and machine learning, to option pricing and derivative pricing as being this evolution, because I think we all want to get to the gold star at the end but sometimes you just got to get your feet wet and start experimenting because there's a whole suite of other considerations that probably happen when you start to get your feet wet, could be getting the right tech talent within your organization, could be understanding the regulatory environment, could be the infrastructure inputs. I can imagine how just starting the experimentation process would open your eyes to all the things you need to do.

Mekena McGrew: I think there's a transformation problem ahead of the quantum computing industry. It's one thing to do a POC (proof of concept) with some synthetic data or public data and you're like “Oh, this is really cool”. How do you get that into production at a bank? How do you even get quantum inspired into production at a bank… is another question entirely?

So, you have to deal with security of software on-boarding. You need to make sure you have the right computers where your data sits, either this is on-prem (on premises) or in cloud. And one that I think is lingering comes back to regulators. And so, even with the quantum inspired models, the quantum machine learning models, financial institutions have to think about risk and governance. So that you can go to a regulator and be like “we're using this model, let's say, to do value at risk calculations, and we can trust it for X and Y reasons” and so, when you even think about upskilling, it's not just data scientists who are going to execute the algorithms, it's everything around it to be able to actually move something into production.

And that is not an easy task, right? And so, I think that's where the value of having even a small quantum team can be helpful because they're able to attack and think about these from all the different directions while also pushing use cases forward, while also trying to assess business value from the outputs that are coming from these algorithms.

Raquel Buscaino: I mean the way that you've outlined it, there’s definitely a lot to consider. There's obviously a lot of benefits that you can gain from adopting and embedding quantum inspired algorithms into your organization. What are more of the challenges that leaders would need to consider to best prepare for their roadmap? We talked a little about upskilling talent and being cognizant of regulations, is there anything else here that you think is worthwhile to mention?

Mekena McGrew: I think one of the big challenges is going to be with the architecture teams. So, let's say hypothetically, in the next year, we see commercial application in financial services on a quantum computer. Then, what? These quantum computers are expensive, they don't necessarily sit in the data centers that a financial institution might use, you can't necessarily bring it on-prem because the operating cost is so high. And I like to draw parallels between GPUs and quantum, because I think it's a tale of a future state, which is the price surging around GPUs and the unavailability for GPUs unless you pay a lot of money for reserved instances. And quantum computers aren't going to scale as fast as GPUs for these AI workloads. And so, it's going to be the people who were early on, who already had those relationships with the hardware vendors, who already have been considering how they might migrate data over to a quantum computer that are likely going to have a huge advantage.

Raquel Buscaino: And what you just highlighted to me too, through this is thinking about your ecosystem and alliances as foundational from the jump, and how you engage with the broader industry. Everything, from government grants to tech startups, to research institutions, to even engaging different business units within your company along the way, it just seems like there's going to be a high degree of collaboration needed on so many different fronts. It's not as simple as “Hey, I'm just gonna go put my tech team on it, you know, have someone mock it up”. And then we're gonna go from there”. Right? It's a bit more of a strategic effort here.

Mekena McGrew: Yes, absolutely.

Raquel Buscaino: You had mentioned one thing, your work in fraud. Can you tell us more? Maybe just really quickly. You know, what are some of the near-term use cases and applications within the financial services industry?

Mekena McGrew: So, what's happening in fraud and financial crime is quite interesting, and even though we have traditional AI algorithms trying to classify fraudulent/non-fraudulent behavior, trying to find patterns in financial criminals. I think In the UK fraud has been rising significantly, even though we are starting to use machine learning algorithms to tackle fraud, and banks are the final defense mechanism between a customer, a consumer and criminals. And so, it's really important that we start thinking about new ways to confront fraud. So, one of the ways is to apply quantum machine learning techniques to be able to improve the accuracy of fraud classification. So, this means capturing more fraud, keeping false positives lower, better than the traditional AI models that classical algorithms do.

And what's interesting about fraud, and I think this is good to think about other use cases within your bank, because not every use case is like this, where small improvements in like basis points and accuracy leads to really big returns and fraud turns out to be one of them. Other cases where you do see improvements in accuracy, it might not really matter that much, right? Maybe not a good use case, but fraud and financial crime, money laundering, money mules, this is really important to consider.

And then one of the other ones that I think is starting to emerge from a quantum inspired perspective is value at risk calculations, Monte Carlo simulations. I don't think that's going to be a quick win. And this is the challenge, these models that are used for value at risk, that are used for trading, are very sensitive. Sensitive in the fact that the IP associated with the model being used by a bank is not something that they want to share. And so how do you approach these very high value use cases with quantum-inspired approaches when they are touching the most sensitive aspects of the bank?

Similar with fraud data, you can't let people see your fraud data, because if anyone knew what data you were collecting by fraudsters, they'd change their behavior, so your model will no longer be performant. So, these things get sensitive, they're high value, there's immediate impact to be found but there's a lot to consider when pursuing this type of use case.

Raquel Buscaino: That's a super helpful framing that highlights, yeah, what would some of these good use cases be, to your point, where you can a small improvement in accuracy yields large results, but to the point you mentioned afterwards, a lot of it depends on the sensitive nature of the use case you're working in as well. As we start to head towards the back end of our episode today, what are the far out impacts? What are maybe a decade out that once we get there, man, that's going to be exciting? And feel free to broaden it beyond financial services, too.

Mekena McGrew: I will say in financial services, getting speed ups in derivative pricing, options pricing value-at-risk calculations, having real time business, higher frequency trading than it is already today; that is going to generate a lot of money, but it's a lot further out. You can also think about an even farther future state where you have quantum computers connected by quantum networks, and there was a protocol that showed speed ups in doing trading across the quantum network that actually yielded higher return values. Those are going to be majorly impactful. But again, this is a far future state than we have today. I think that's why it's worth continuing to keep this field going, because over time, the impact is going to grow and grow and grow, and there will be an inflection point. The way that I see it, it's like small investments now are going to result in much larger future returns.

Raquel Buscaino: As we wrap up our discussion here, what would be your piece of advice for any listener that's curious to learn more about quantum?

Mekena McGrew: For those who are technical, there are a host of resources available online that provide hands-on training to get started in quantum computing at the application level, and it really requires a little bit of python code and an API call. So, there's nothing stopping anyone from getting started. The resources are there.

Raquel Buscaino: I love that. Well, Mekena, truly thank you so much for a great discussion. I learned so much throughout the last little bit of time together here. Thank you to all our tech savvy listeners out there. If you enjoyed this episode, please share and subscribe, and if you'd like to learn more about quantum computing and financial services, you can follow myself and Mekena to stay up to date. Our socials are listed in the episode description.

Thanks for tuning in, and I'll see you on our next episode. Until then. Stay Savvy.

Deloitte Legal Information

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee (“DTTL”), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as “Deloitte Global”) does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the “Deloitte” name in the United States, and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see www.deloitte.com/about to learn more about our global network of member firms.