

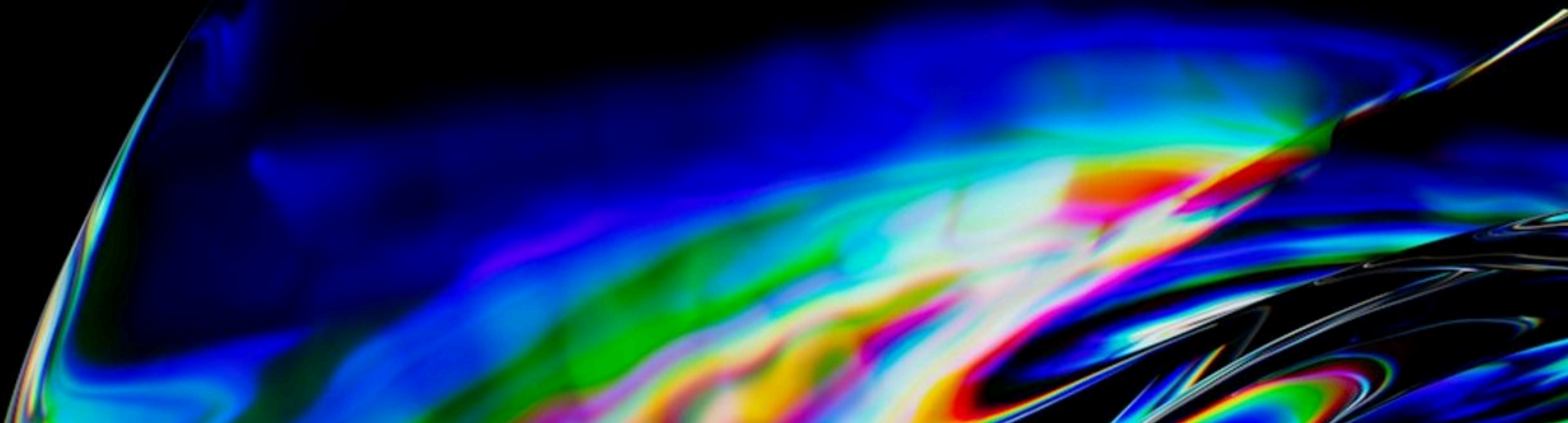
Quantum Computing in Financial Services

How Capital Markets Executives can develop a strategic approach to evaluation and future adoption



Introduction

Quantum computing is fast emerging as a technology heralding profound implications for the financial sector by presenting the opportunity of revolutionary advancements in computational power...



For some capital markets and financial services businesses, especially those with a high dependency on very computationally intensive tasks, failure to adopt future quantum computing technology may even outright jeopardise a firm's ability to compete. In this article we will explore the current state-of-the-art and the future potential application of quantum computing within financial services, highlighting both the areas of promise and its limitations. Our goal is to provide senior executives with actionable insights on preparing for a quantum computing future and motivating them to anticipate drivers for change which are emerging from a complex but commercially rewarding field.

In an attempt to put the opportunities presented by quantum computing into context, we aim to explain the significance of the quantum computational advantage. We will also seek to demystify a little understood fundamental aspect of quantum computing which is key to how quantum calculations are actually performed. This is the role of the "oracle". What it is and does and exactly how this enables the power of this technology, determining where quantum computing can dramatically outperform today's computing technologies as a complete game-changer, and where it cannot.

Our goal is to enable executives to formulate clear, actionable roadmaps to help prepare and position their organisations for this future technology by understanding where the real business opportunities exist, and to prepare to take advantage of quantum computing when it becomes a practical and deployable business solution.

Given the pace of change and development advances in quantum computing, that future may not be very far away. In just the past week, Google has announced a milestone achievement in overcoming one of the obstacles to practical quantum computing. This is a limitation of quantum computing which has been grappled with for decades but is now on the cusp of being solved at scale.

Understanding Quantum Computing's Potential and Limitations in Financial Services

Anyone who has read anything about quantum computing is probably aware that quantum computing leverages principles of quantum mechanics to solve problems at speeds that today's "classical" computers cannot achieve. Few actually understand however how the nature of that ability to perform faster calculations or scale those calculations comes about from the technology, or indeed the degrees of scaling that are possible. The complexities of the science may be baffling, but a basic understanding of the nature, scope, capabilities and applicability of quantum computing to activities in financial services is what we seek in this article. We suggest approaches to enable executives to guide future projects and identify clear opportunities for future competitive advantage.

Putting the quantum computing calculation advantage into perspective

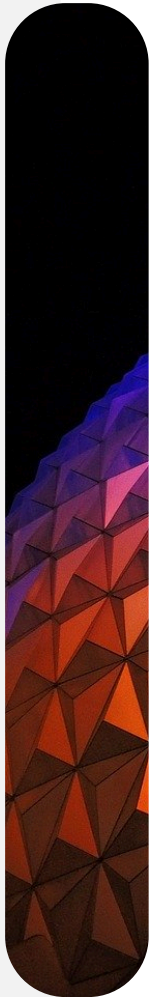
Invariably articles about quantum computing will say that quantum computers can do more, faster and bigger calculations than classical computers. But what exactly do we mean by “more”? Let's try to put this into perspective, and get a sense of scale.

Very simply, the difference between classical computing and quantum computing is that the bits in a classical computer can only hold and interrogate one permutation of those bits at a time. A quantum computer can consider every possible permutation of those bits all at once. At the top level it is that simple - that is the difference between classical computing and quantum computing. But what a difference that makes. As ever that isn't quite the entire story because this is tempered by certain limitations in the quantum approach to performing those calculations. The slight fly in the ointment for quantum computing is that performing the calculation just once does give an answer, but there are probabilities associated with that particular result being correct. Quantum computing does have an approach to dealing with this issue, but this is a point we will come back to later.

When you are sitting at your desk, and assuming you are using a fairly average desktop computer of today, the chances are it has a 64-bit processor. That fairly average CPU may well contain 14 cores. What that ultimately means is that the CPU is capable of holding 64×14 bits, a total of 896 bits, at any single point in time in a single permutation of all of those bits.

That relatively small number of 896 means that the total number of permutations of the settings of that set of bits is 2^{896} . Given that the number of atoms in the observable universe is something around 10^{80} , having simply considered the possible permutations of an average CPU we have suddenly arrived at a very big number describing all of the unique ways in which those bits can be set. Let's contextualise that in terms of computing power and the ability to process this also. If we wanted our computer to consider every possible permutation of that set of bits, and say the computer can check each one of them at the rate of 1 billion per second, we're going to have to wait a while as this would take an amount of time many multiples the current age of the universe.

But as mentioned above, a quantum computer holds, and can consider all of these permutations at once. So then why don't we just run the calculation once through the quantum computer and produce the answer?



Well, that is where the nature of quantum mechanics comes into play and the inherent advantages of the science also come with a limiting factor. A quantum computer assesses all of those many possible answers at once through probabilities. When the computer gives a result, it comes with a probability as to whether it is correct or not. If you run one single quantum calculation and it produces a result that only has a 20% probability of being the correct answer, that isn't an answer you will want to depend upon.

Fortunately there is a way of addressing this, and that is to repeat the calculation multiple times, because those probabilities also have a frequency distribution and the "right" answer will be the one that emerges most often, if you repeat the calculation a sufficient number of times. The result with the highest frequency which also reflects the right result, in effect, rises to the top - it is "amplified". Once enough repetitions have been performed for the calculation in question, the answer has been found. The number of repetitions is driven by a desired statistical confidence level and varies depending on the nature of the calculation. In the quantum computing world 100% certainty is not achievable, but extremely high probabilities are. For example in the case of cryptography where high levels of confidence are essential a confidence level of 99.999%, referred to as "five nines" is considered to be adequate.

The quantum computing advantage is the trade-off between the difference in the number of times a classical computer has to perform each permutation of a calculation versus how many times a quantum

computer has to repeat one calculation to achieve sufficient confidence in the result. The advantage being that the number of repetitions in the quantum computer is significantly less than the total number of calculations required by a classical computer. This quantum advantage is described in various ways and expressions such as "speedup" and "scaling" are used in the context of this computational advantage.

But what then determines the number of times we would need to repeat the quantum calculation? There are various factors influencing this, one of which is the actual engineering of quantum computers themselves. As of today, quantum computers are regarded as "noisy" and it is that noise which introduces errors when the calculations are performed, which increases the number of times a calculation needs to be repeated. The noise arises from multiple sources, not least of which are physical engineering challenges.

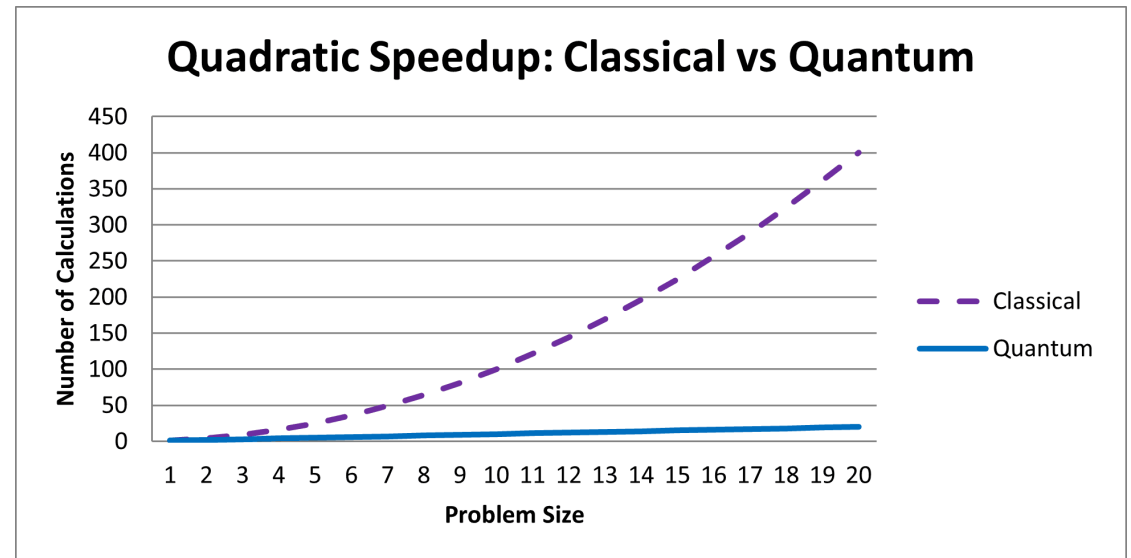
But Google's latest announcement regarding their Willow quantum computing chip is that the challenge of reducing errors is being overcome. Not only have Google found a way to reduce errors, but the reduction of those errors shows exponential improvement.

A key factor that is critically important in determining how many times a quantum calculation needs to be performed is the nature of the quantum algorithm required for a particular type of calculation. Some quantum algorithms require more repetitions to amplify the likelihood of identifying the correct result than others. This in turn affects the degree to which computational speedup can be achieved. The nature of the algorithm's method itself determines the form of speedup that can be achieved.

Amongst the various quantum algorithm speedup possibilities some are of direct relevance to the computational activities of financial services firms. For the moment let's consider just two forms of speedup, quadratic and exponential.

Quadratic speedup is of particular relevance when calculating Monte Carlo simulations. Whereas exponential speedup plays a role in calculations for financial modelling such as forecasting and value at risk calculations as well as risk factor modelling.

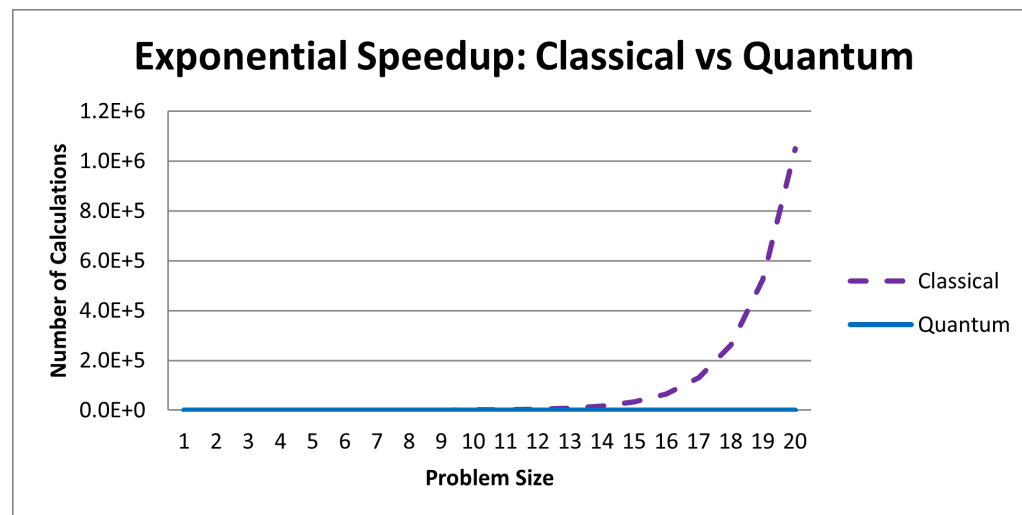
So, given that we anticipate quantum computational advantage and speedup benefits from quantum computers, in order to understand the degree of benefit let's illustrate this graphically:



Considering quadratic speedup, the chart shows that there is a dramatic reduction in the number of calculations required to be performed by a quantum algorithm versus a classical algorithm. The slight curve in the line for the classical algorithm reflects the fact that certain calculations such as optimisation require more, and increasingly intensive computation with classical computers.

For calculation problems especially relevant to financial services firms such as Monte Carlo simulations, we can already see the potential enormous benefit if we are able to deploy quantum computers for these types of calculation.

But this is only one form of speedup so let's give some consideration to our other example which offers an ability to perform large calculations even faster, the clue being the word "exponential":



If an important aspect of your firm's activities is performing value at risk or forecasting calculations or various other forms of financial modelling then you could certainly make use of quantum algorithms. You would benefit from exponential speed up, meaning that the deployment of quantum computing would offer an utter game changer in terms of computing power available to you.

Given that the nature of the calculation gives rise to the selection of the underlying quantum algorithm, the business computational need therefore determines the degree of quantum computational advantage that can be achieved.

Let's reflect back on our desktop PC with 896 bits. If we are trying to perform a calculation that can benefit from exponential speed up, without going into the details of the underlying algorithm (but it could be Shor's algorithm if you are really interested) a quantum calculation considering 896 bits, due to these quantum computing scaling advantages, requires approximately 719 million calculation operations. A quantum computer can process around a million calculations per second, so in this simple example we can estimate that this calculation with a mind-bending number of permutations of bits (2^{896}) would take around 719 seconds, or about 12 minutes.

The story however, is somewhat different when it comes to quadratic speedup, and unfortunately not as advantageous for this example. In the case of quadratic speedup the number of iterations required is the square root of 2^{896} or 2^{448} , and once again if we assume a million operations per second, the amount of time required to perform this is 2.3×10^{121} years - a trillion trillion trillion trillion trillion trillion trillion years.

If you have ever looked for an example of a vast chasm in performance outcome based upon a seemingly trivial difference in calculation approach, this one is surely hard to beat. That doesn't mean that quadratic speedup offers no benefit. But it does mean that the type of calculation in the context of quantum computing is very important. As we move into a world where quantum computing becomes a reality in financial services it is incredibly important for executives to understand this. Quantum computing is definitely not a one size fits all solution.

Quantum computers are exceptionally powerful when solving problems with exponential complexity, such as factoring large numbers or optimising complex systems. However, they do not outperform classical computers for tasks with low computational complexity, deterministic outcomes, sorting data or calculations with simple arithmetic. Quantum computers are extremely good at taking a large number of possibilities and identifying the best result and there is no obvious underlying rule to determine what that result might be. However, if we were to use quantum computer to calculate the result of $a + b = c$, no matter how big a or b are, the quantum computer isn't going to offer you any dramatic improvement for that calculation.

Quantum computing is best seen as a complementary tool, not a universal replacement for classical systems.

A reader might consider that for the purposes of this article deliberately large and provocative numbers such as our CPU example of 2^{896} bits have been chosen, but this is not the case. Here and now, today, IBM's Condor processor utilises 1,121 qubits, comfortably exceeding our example of 896 classical computing bits.



Hopefully we are conveying that while the potential of quantum computing is, in certain areas truly staggering, it is not a panacea for all computational problems, and that the nature of the calculation you need to perform also needs to be taken into account. Executives should be equipped to identify opportunities where quantum computing can have enormous impact and separate these from circumstances where expectations should be tempered. Investing ahead of time to understand this subject matter will enable executives to plan their business models in anticipation of the availability of this exceptionally powerful upcoming technology.

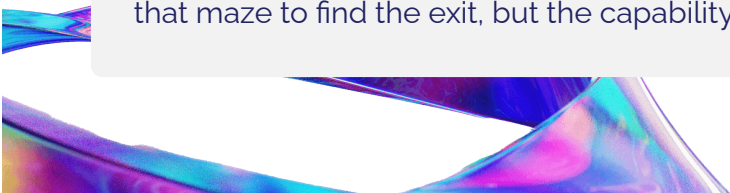
Quantum magic: Understanding the Quantum “Oracle”

Knowing that a quantum computer holds a collection of qubits all in a state of superposition, in other words collectively holding every permutation of those bits at once, how does this get converted into an answer?

For anyone who has seen any of the numerous explanations of quantum computing there is usually much discussion of quantum entanglement, superposition and other aspects of the science but little explanation of how this actually creates a result from a quantum calculation.

Let us try to cast some light on this by explaining a key aspect of the quantum calculation process, the oracle - an essential yet often barely understood aspect of how a quantum computer works. In simple terms the oracle is a powerful technical shortcut in a problem-solving process.

Imagine being in a maze where you don't know the right path. The oracle is like a guide that tells you whether you're closer to the exit after each step, without revealing the whole map. The oracle doesn't know the answer, but it can determine whether a possible answer is more or less likely to be correct, and so it enables you to narrow down the correct answer, and in this example find the exit to the maze. This echoes the underlying difference between classical and quantum computing, in that a classical computer would need to check every possible path in that maze to find the exit, but the capability of the oracle gives quantum computing a powerful shortcut by ruling out incorrect possibilities.



The oracle is tailored to understand information about what makes an answer correct, without actually knowing what the answer is. It is coded to understand a particular mathematical property, specific pattern or perhaps a target value to identify whether a particular potential solution is more or less likely to be correct, and this is expressed in the form of a mathematical function.

The oracle itself is a subroutine that is contained within a larger algorithm, such as one of the algorithms that enable the speedup possibilities we discussed earlier. The oracle is implemented in a quantum circuit by arranging a set of quantum gates corresponding to the mathematical function identifying the correct answer.

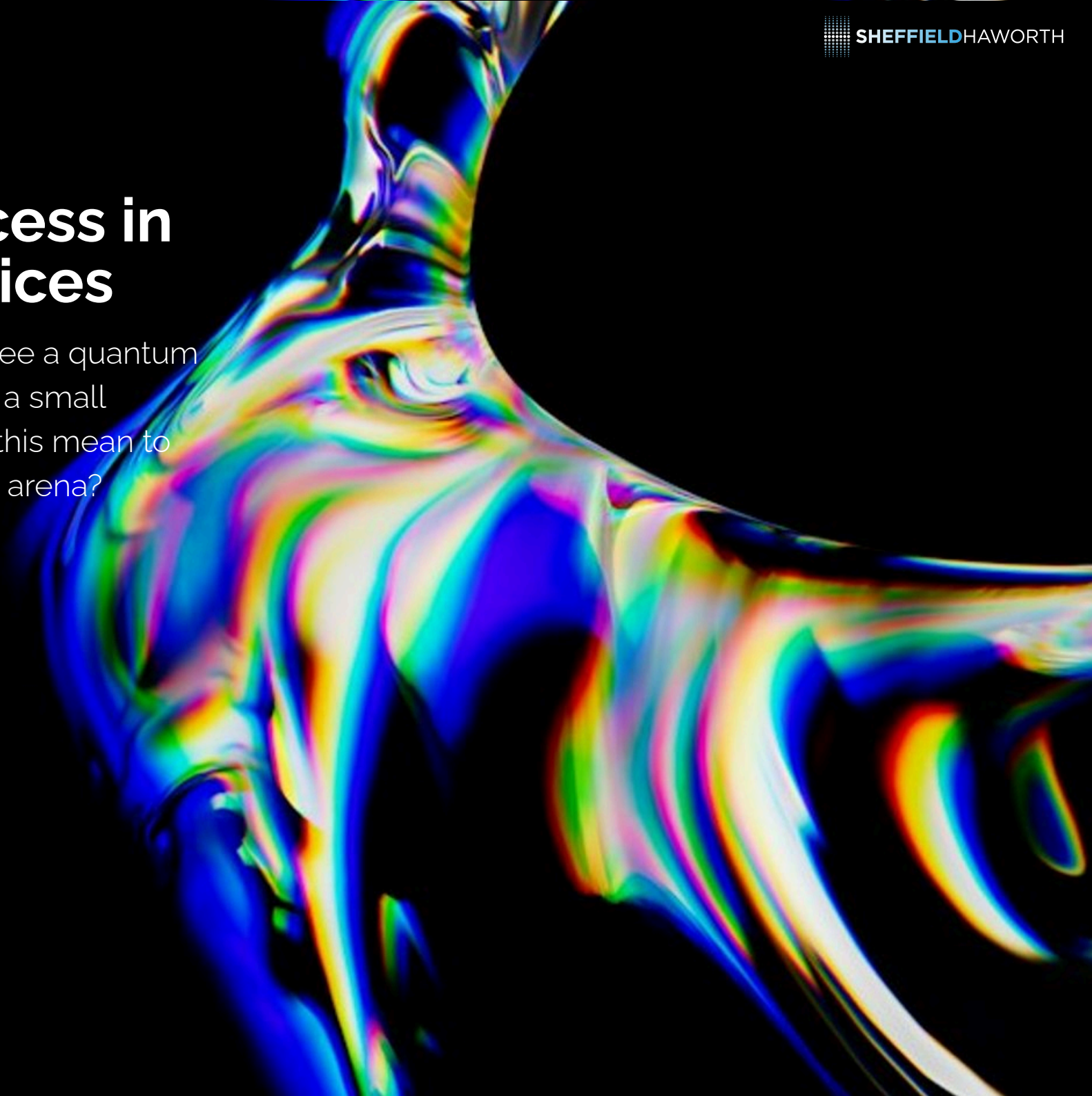
When the oracle encounters a state of the qubits that the underlying mathematical function identifies is likely to be correct, the oracle has a technical way of marking that particular result. We mentioned earlier the concept of amplifying the correct answer, and this is exactly where that amplification takes place.

Then depending on the type of algorithm required and therefore the degree of speedup, the calculation needs to be repeated a certain number of times. After enough calculation repetitions with the oracle marking and amplifying individual answers, the result with the highest frequency is the right answer.



Key Areas of Potential Success in Financial Services

So, given that we may well see a quantum computing future emerge in a small number of years what does this mean to activities in financial services arena?



Given the strengths and weaknesses of quantum computing we would suggest that the most promising areas of application include the following:

- **Risk Analysis and Optimisation:** Monte Carlo simulations, which are essential for risk assessment and derivative pricing, are notoriously resource-intensive on classical computers. Quantum computers, however, can run these simulations exponentially faster, enabling analysts to evaluate millions of scenarios simultaneously.
- **Portfolio Optimisation:** Quantum computing can manage and solve complex optimisation problems more efficiently than classical methods. This could transform how financial portfolios are constructed by rapidly identifying the optimal allocation of assets under various constraints.
- **Fraud Detection and Cybersecurity:** Quantum computing can aid in pattern recognition, crucial for fraud detection. Furthermore, quantum algorithms could play a significant role in securing transactions, especially as quantum-resistant cryptographic protocols emerge to counter potential threats posed by quantum's ability to break traditional encryption methods.
- **Processing and analysis of unstructured data:** Tasks such as sentiment analysis, trend identification, and topic extraction benefit from quantum-enhanced machine learning and optimisation. Quantum computing can analyse and categorise unstructured data such as newsfeeds faster and more accurately than classical methods, enabling the faster and more efficient uncovering of new insights.
- **Generative AI and Quantum Synergy:** The integration of GenAI with quantum computing offers possibilities that are only beginning to be explored. In finance, this synergy could lead to advancements in predictive modelling, automated customer insights, and even adaptive financial advice tailored to real-time market shifts.

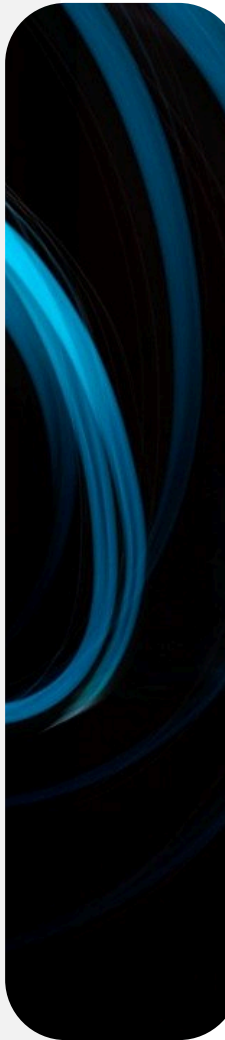


While quantum computing shows promise, and leaving aside the challenges of improving upon quantum error correction, it is far from universally applicable or instantly transformative and there are a range of challenges and limitations to be taken into account:

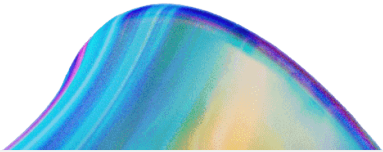
- **Data Constraints:** Quantum computers currently work best with specific types of data inputs suited to quantum algorithms, limiting their applicability in standard transaction processing or other less complex operations.
- **Cryptography Risks:** There is considerable debate around quantum computing's future ability to break traditional encryption standards. Though quantum-resistant cryptography is a developing field, this potential risk is a long-term consideration rather than an immediate concern.
- **Hardware and Scalability:** Quantum hardware is still evolving, with challenges around error correction, cost and scalability. Investments made today will take time to yield results, so a cautious but proactive approach is advised.

While much is made of the risks of quantum computing being able to break existing industry grade encryption, this is a future not present risk. However, even now firms should be taking this into account in how they protect and store their data. Executives should keep a weather eye on the development of quantum safe cryptography, with a view to deployment sooner rather than later. Similarly, any data that could still have value to bad actors years into the future does of course need to be highly protected. Executives might want to give some thought to categorising data which has long-term value versus data which does not. Of course all data needs to be protected, but in a world where the concept of harvesting data now for future decryption is a distinct possibility, it should be a fair assumption that data unlikely to have any future value is at least a lesser concern. Security comes in different degrees, as indeed does the future value of the underlying data.

The challenges and limitations of quantum computing hardware and scalability should be outside of the concerns of a financial services executive, with one key exception of maintaining a close awareness of the speed of advancements in these areas. Much like Google's announcement in the past week, as significant technological milestones are achieved the timeline until general availability of mainstream quantum computing for financial services firms is going to change. If we see rapid evolution of this capability, firms will need to be prepared even sooner for deployment.



Shaping your Data Architecture

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While there may be relatively little that can be done today in respect of cryptography and hardware limitations other than watch and wait, when it comes to data this is quite a different story.

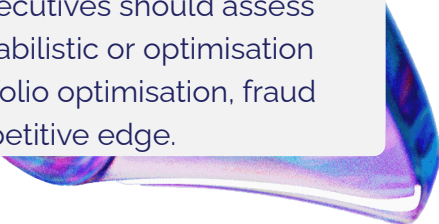
Preparing now for an environment where data is structured, stored and made available in formats that are compatible with future quantum computing services will give firms a massive head-start over competitors that do not.

Quantum computers can excel when working with specific types of data inputs that align with their unique algorithms and quantum mechanical properties. In financial services, they perform particularly well with structured data used in optimisation problems, such as portfolio management and risk analysis.

Probabilistic and statistical data lend themselves well to quantum applications, such as Monte Carlo simulations for pricing derivatives or assessing risk. High-dimensional and complex datasets, such as those needed for market behaviour modelling are also well-suited for quantum processing.

Unstructured data however, such as raw text or audio files, which can contain enormous value needs to be preprocessed into a structured format. Deciding and acting upon the approaches for preprocessing of this data, including the careful construction of metadata is a task that can be undertaken immediately. As we see significant growth in GenAI, this task aligns very well with a current business development need as GenAI also thrives on processed unstructured data.

For senior executives evaluating quantum computing, it is crucial to understand their organisation's data landscape. Executives should assess the complexity and structure of existing data and prioritise datasets that are clean, structured, and well-suited for probabilistic or optimisation models. Identifying and preparing a data architecture underlying high-value, complex financial problems, such as portfolio optimisation, fraud detection, or risk management, will help determine where fast deployment of quantum computing will provide a competitive edge.

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Investing in data readiness is essential. Organisations should already consider establishing robust data pipelines and storage solutions to preprocess and structure data in formats compatible with quantum systems. Commencing preparations for a hybrid data-processing approach, where classical systems handle preprocessing and future quantum systems tackle high-complexity calculations, may also be advisable. Where possible, datasets should be organised into particular formats such as matrices that align with quantum algorithms.

Scalable infrastructure should also be implemented to store and process the high-dimensional datasets required for quantum applications; another very strong and compelling argument for cloud deployment.

Additionally, simulating quantum use cases on classical systems can help organisations identify data gaps and refine their approach, ensuring they are ready to leverage quantum technology as it becomes available. Preparing your data environment now will position you to be able to capitalise on the transformative potential of quantum computing in financial services.

Quantum Computing and GenAI

Generative AI is already transforming business processes across industries, showing its potential to drive efficiencies and uncover opportunities. Quantum computing, while in an earlier stage of development is advancing rapidly and presents a highly complementary capability. Together, these technologies have the potential to redefine the possibilities for businesses, particularly in financial services, where the ability to process and analyse vast, complex datasets is paramount.

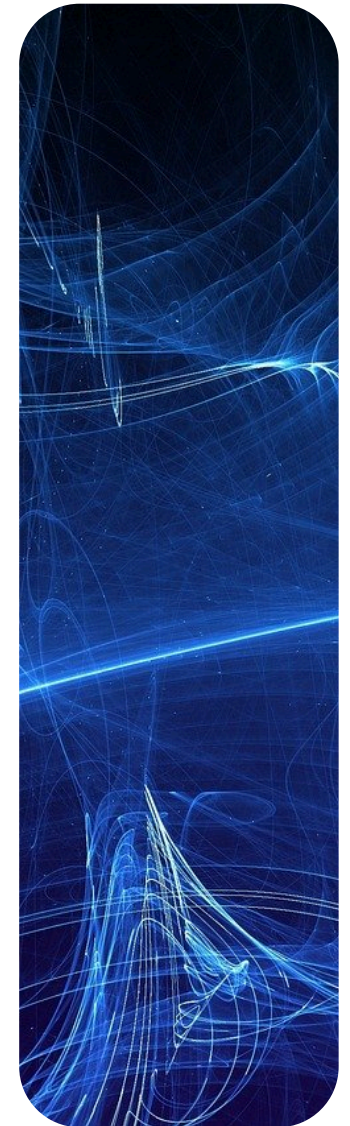
Financial institutions rely on massive quantities of data for tasks like risk assessment, fraud detection, and customer personalisation. Generative AI excels at recognising patterns in data and generating realistic synthetic datasets, which are invaluable for simulations, testing, and decision-making. As datasets grow in size and complexity, however, the computational demands for training and operating generative AI models increase dramatically. This is where quantum computing enters the equation. Quantum systems are inherently suited to solving high-dimensional optimisation problems and handling probability distributions efficiently, enabling faster and more precise data synthesis and analysis.

Training generative AI models is a resource-intensive and costly process, often requiring significant investments in computing power and time. Increasingly, financial services firms are choosing to conduct their own model training and so quantum computing definitely has a role to play. For financial services firms training models means days or weeks of intensive computation to model market scenarios or simulate customer behaviour. Quantum computing offers the ability to dramatically accelerate this process. By optimising key elements of the training cycle, such as minimising loss functions and exploring high-dimensional data spaces, quantum enhanced systems can deliver results in a fraction of the time, reducing resource demand, costs and minimising operational limitations.

The implications for financial services are profound. In risk management, GenAI combined with quantum computing can enable institutions to stress test portfolios with greater accuracy and simulate a broader range of market conditions. This combination of technologies could revolutionise predictive analytics, allowing firms to model complex market behaviours more effectively and gain a competitive edge. In fraud detection, the enhanced ability to identify patterns in high-dimensional data could make it easier to detect anomalies and prevent financial crimes.

Quantum-powered generative AI also holds promise in areas like product development and customer personalisation. In wealth management, for instance, these technologies could be used to generate tailored investment strategies by analysing an individual's risk tolerance, market conditions, and historical data. Similarly, they could help insurers design custom policies that balance risk and reward more precisely.

This technological convergence isn't just a theoretical possibility, it represents a paradigm shift in how financial services firms will be able to approach data driven challenges. By embracing these technologies, firms can unlock new efficiencies, create more personalised client experiences, and maintain resilience in an ever-changing economic landscape. Those who act early to explore and invest in the potential of quantum-enhanced generative AI will position themselves at the forefront of the next wave of innovation in financial services.



Financial services and Quantum Computing

The Road Ahead

Quantum computing represents a fundamental shift in how financial institutions can approach complex challenges in risk management, portfolio optimisation, and fraud detection amongst other key financial services computational activities. While practical applications are still evolving, those who understand the potential and limitations of this technology will be well-positioned to make strategic investments that pay dividends as quantum hardware improves and becomes available to mainstream industry.

Senior leaders should begin preparing now for the eventual and indeed inevitable impact of quantum computing by taking strategic preparatory actions aligned with both short and medium term objectives. Here are some recommended steps:

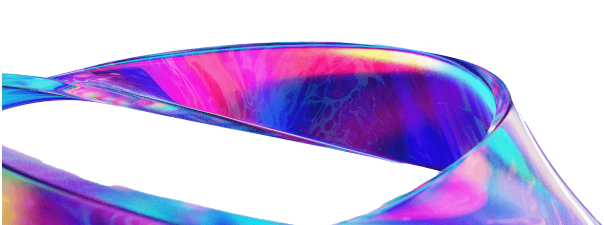
- **Educate and Engage:** Build internal awareness of quantum computing's potential through workshops or executive training. Initiate discussions with quantum experts and industry peers to understand practical implications for your organisation.

- **Preparing your data environment and data architecture:** Data is the lifeblood of financial services, and the more value that can be derived from your data the more competitive your firm will be. The game changing capabilities of quantum computing are going to create data analytics capabilities simply beyond anything that could be envisaged with today's technologies. The ability to deploy quantum computing will be shaped by the preparedness of your data environment and data architecture.

- **Pilot Programs for Quantum-Ready Projects:** Begin experimenting with quantum-inspired algorithms on classical systems, particularly in areas like portfolio optimisation and risk management. These algorithms can offer improved performance even without quantum hardware.

- **Explore Partnerships with Quantum Providers:** Develop relationships with quantum solution providers and research institutions. Many technology firms offer "quantum as a service" (QaaS), allowing companies to experiment with quantum applications without needing in-house quantum infrastructure.

- **Invest in Quantum-Resistant Cryptography:** Although immediate threats are limited, transitioning to quantum-resistant cryptography can future-proof systems, especially for highly sensitive data.



Medium-Term Actions

- **Upskill Your Workforce:** Foster a team of data scientists and software engineers with specialised training in quantum algorithms. This may involve sending staff to advanced training or hiring specialists familiar with quantum computing principles.

- **Develop a Quantum Roadmap:** Incorporate quantum computing into your organisation's strategic roadmap. Identify which business areas may benefit from quantum developments and outline a timeline to assess emerging technologies for potential integration.

- **Engage in Collaborative Research:** As quantum computing matures, joint research with academic and industry leaders will enable your firm to stay up to date with advances. Consider participating in consortia or working with innovation hubs focused on quantum advancements.

- **Monitor Quantum-Generative AI Synergy:** Stay informed about advancements in quantum computing's interplay with GenAI. By exploring these technologies together, your firm may gain unique predictive insights or automation capabilities that redefine decision-making processes.

By proactively exploring and preparing for quantum computing, financial services executives can set their organisations on a path to remain competitive in an increasingly complex technological landscape. While quantum computing may not be universally applicable, its transformative potential in areas like risk analysis and optimisation cannot be ignored. Leaders who act today to prepare for this inevitable and extraordinary technology will be better equipped to leverage this next generation of computing for a strategic business advantage in the future.

We hope this article has helped to clarify how senior financial executives can begin integrating quantum computing into their strategic thinking. By presenting a practical approach, the aim is to empower decision-makers to embrace the potential of quantum computing and prepare for its transformative impact.

Our Specialists



Marcus Hooper, *Advisor*

Marcus is an accomplished, delivery-focused programme director with extensive financial markets, technical project management & business analysis experience. He worked for over 20 years in senior front office management roles for major asset managers, investment banks and exchanges and has excellent regulatory domain experience having been an FCA authorised Chief Executive.

- He has a track record of leading global technology change programmes, and development of investment bank target operating models.
- Highly experienced in acting as the senior connection between business managers and technology teams, with a flair for decomposing complex workflow problems, innovating solutions, identifying & mitigating risks and delivery of transformational
- ~~Experience working~~ **Technology working** with modern applications teams: led the team that won Schroders' first datathon with a machine learning solution
- Consumer Duty champion for the business



Adriaan Hugo, *Executive Director*

Adriaan is an Executive Director in the Consulting Practice at Sheffield Haworth. His core experience is in business and technology transformation within financial services – both buy side and sell side. Adriaan works closely with a range of clients as a trusted advisor helping them to solve complex issues and deliver successful outcomes across Risk, Regulatory and Technology Change. Adriaan joined SH Consulting in 2015, which was acquired by Sheffield Haworth in 2019, where he started as an Engagement Manager driving business growth and supporting the delivery of strategic and tactical change programmes. He works closely with a range of Investment Banks and Asset and Wealth Managers providing them with specialists for Change and Transformation initiatives. He has developed excellent relationships with clients delivering Consultancy engagements for Front, Middle and Back Office solutions and system implementations. Adriaan's success with clients is built upon a friendly professional demeanour, an instinctive curiosity, and a conscientious approach to delivery.

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