

Quantum Computing

An Interview with Markus Pflitsch, Chief Executive Officer and Founder, Terra Quantum

EDITORS' NOTE Markus Pflitsch is a quantum physicist, senior financial executive, and deep-tech entrepreneur. He believes in the competitive advantage of quantum tech and is committed to supporting the European ecosystem to unlock its value. Since he was 14 years old, Pflitsch has been a quantum physics enthusiast. He built on that passion, studying mathematics and physics, and pursuing a research career at CERN, the European Organization for Nuclear Research. He also built a career in business and finance, starting with the Boston Consulting Group in Europe and North America and going on to serve as an executive and financial officer for several international firms. He brought his scientific training and business experience together in 2019 when he founded Terra Quantum.



Markus Pflitsch

COMPANY BRIEF Terra Quantum (*terraquantum.swiss*) is a leading quantum technology company headquartered in Germany and Switzerland. It consists of three core services. The first provides customers with access to an extensive library of algorithms that can be used for solving complex problems in the domains of optimization, machine learning and simulation, among other things. It also develops new quantum algorithms for customers or adapts existing algorithms to their specific needs. The second division offers a hybrid quantum computing, including access to simulated and physical quantum processors hybridized with classical high-performance computers. The third division is “Quantum Security as a Service” through which Terra Quantum offers unique solutions for secure quantum and post-quantum communications worldwide. Terra Quantum is also part of a joint venture, QMware, which is a leading provider of hybrid quantum computing cloud services.

What was your vision for creating Terra Quantum and how do you define its mission?

Terra Quantum is built on our conviction that quantum technology is the future of computing. Quantum computing applies the laws of quantum mechanics to solve problems that are too complex for even the most advanced conventional computers. Our vision, therefore, is to be on the cutting edge of this new, game-changing technology. We want to lead the quantum revolution and be the trailblazer in technology solutions,

shaping a better future for humankind to prosper in. Our mission can be summed up this way: To unleash the power of quantum tech to deliver meaningful solutions today.

Will you discuss how quantum computing works?

It is now well known to physicists that physical matter at the subatomic level exhibits behavior that is fundamentally different than on a macroscopic level, something that was once inconceivable. Quantum computing leverages this behavior. We do that with hardware that manipulates the basic unit in quantum computing, known as the “qubit,” short for quantum bits. The bits in classical computers can only be 1 or 0. Qubits can be one or the other – or both at the same time. Through this effect, called superposition, and another one correlating the qubits in all possible ways, called entanglement, quantum computing can evaluate many possibilities at once. That capacity can exponentially increase the speed of hybrid calculations.

I don't want to overstate the case, however. At this point in time, we are still facing limitations on the capabilities of quantum hardware. Even though we see rapid maturing of the hardware – and even

though there is impressive progress in this space – the purely quantum hardware of today is not yet capable of solving large-scale industry applications on its own. This creates both science and engineering challenges: How to best utilize and isolate quantum effects and build systems that can leverage these for computation.

Will you provide an overview of Terra Quantum's products and solutions?

We have identified a use-case portfolio of 50-plus opportunities across industries that will benefit from hybrid quantum computing. These industries include financial services, logistics, automotive, life sciences, and pharma. We can solve clients' problems and advance their businesses by tackling their most complex computing problems. We offer practical performance enhancements today, not some day off in the future, shaping their business for tomorrow.

I should add that at this stage in the development of the technology, hybrid computing – by which I mean the hybridization of quantum and classical high-performance computers – is a key part of Terra Quantum's business model. It enables us to address industrially relevant applications today. We use the QMware (a TQ joint venture) cloud for its hybrid quantum computing approach. The unique architecture provides a clear advantage to competitive solutions, offering a fully integrated platform with a shared memory structure. This means that high-performance and quantum computing processes work – literally – in parallel.

Hybrid quantum software applications executed on the QMware cloud are able to access the best classical computing resources seamlessly, without requiring amendments at the application level. As we develop this system, parts of the applications will be executed by classical computing systems, while more complex parts will be executed on quantum systems.

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To address large-scale industrial applications, we develop software applications which showcase world-class performance on the best computing platforms of today – Central Processing Units and Graphics Processing Units – while also seamlessly harnessing the increasingly maturing Quantum Processing Units, as and when needed.

Terra Quantum is focused on being “the European answer to breakthrough and accessible quantum computing technology.” Where are you on this journey?

Headquartered in Germany and Switzerland, Terra Quantum is now one of the leading quantum technology companies in Europe. We were pioneers in the quantum field and therefore have an edge on the competition. We do not envision ourselves, however, as only a European organization. The United States has always been a leader in creating and embracing new technologies, and we intend to be a part of the growth of quantum computing in the U.S. In addition to the U.S., we endeavor to have a leading position globally too, particularly as quantum technologies enhance their impact across the world.

Right now, our quantum algorithms executed on the hybrid quantum cloud can:

- Generate business advantages by solving real-world problems in the areas of optimization, machine learning, and simulation.
- Combine the best of classical and quantum hardware in one integrated platform.
- Seamlessly harness the power of improved quantum processors as they mature.
- Ensure that our partners and clients do not need to bet on a certain type of quantum hardware or a particular hardware player.

What are the opportunities for quantum technologies to change the world for good?

We at Terra Quantum are convinced that this is a revolutionary time in computer technology and that the quantum era promises groundbreaking progress and innovation that is going to transform the world as we know it. As a pioneer in this field, Terra Quantum is committed to applying quantum technology for a better future, breaking down the barriers between science and industry and laying the foundations of a real quantum tech ecosystem and value chain.

In particular, we see enormous potential benefits being harnessed in support of the energy transition and in the field of life sciences. There are also huge possibilities in the realm of quantum security, protecting information as we

approach “Q-Day” when current, classical security systems are increasingly vulnerable to decryption by quantum computers.

What do you see as the intrinsic connection between the planet and quantum technologies?

We value the intrinsic connection between our planet and quantum technologies, putting sustainability at the core of our business and culture. Standing at the very beginning of the quantum revolution, we feel the excitement – and responsibility – for ensuring the applications and tools we are developing are eco-friendly and sustainable.

Quantum computing has the potential to help humankind overcome technological limitations and solve our greatest challenges in business and society. This includes improved energy efficiencies through optimal grid management, rapid acceleration of the drug discovery process, and improved prediction and simulation of complex systems like weather patterns.

Will you provide an example of how quantum computing might be able to help companies across industries?

Terra Quantum has developed unique hybrid algorithms that can explore huge, complex solution spaces faster and more efficiently than classical algorithms, delivering qualitatively better answers than classical algorithms are able to produce, no matter the underlying hardware. Terra Quantum’s proprietary algorithms can be applied to a wide range of optimization and machine-learning problems in various industries. One example would be optimizing the packing of goods within shipping containers. A logistics company needs to maximize the amount of goods that can be packed while at the same time considering various constraints, such as weight limitations and placement directions for each package. This is such a complex computing challenge that shipping containers are currently, on average, only 65 percent utilized. For a large shipping organization that transports about 13 million containers a year, every percentage point improvement in capacity utilization can deliver \$429 million in annual savings. As I said, a game-changer.

And here’s a real-world example of how we have already helped customers. We are able to run enhanced versions of Monte Carlo simulations, often exponentially faster than a classical computer could. Using this approach, for a particular client in financial services, we have been able to reduce the time for pricing options products by 75 percent, giving them a strategic advantage in the competitive world of global financial markets.

Did you always know that you had an entrepreneurial spirit and desire to build your own company?

I can’t honestly say that I always knew that I wanted to build my own company, but from an early age I was enthusiastic about quantum physics. I never lost that enthusiasm, but along the way I did pursue a career in business and finance. Starting at the Boston Consulting Group in Europe and North America, I acquired invaluable experience in the financial services industry. I went on to spend several years as a chief financial officer and senior executive with various corporations including Deutsche Bank and UniCredit, and then as my entrepreneurial spirit came alive, I became an owner-manager of digital and high-tech companies. Ultimately, I found a way to leverage my knowledge and experiences in quantum physics, business, and finance by becoming an entrepreneur in the quantum tech space. And that’s how Terra Quantum came to be.

I might add that I am a senior advisor to private equity funds and a member of the Baden-Badener Unternehmengespräche, a German institution that helps cultivate the next generation of executive leaders by bringing together decision-makers from business, politics, and society.

What do you feel are the keys to effective leadership and how do you approach your management style?

I am fortunate to be surrounded by an incredibly talented, dedicated, visionary team of executives. As CEO, the final decisions are up to me of course, but my leadership style is to get constant input from my team, to let everyone speak freely and to the greatest extent possible, to solve problems collegially. We are also fortunate to have a group of senior advisors whose scientific knowledge and business acumen are absolutely invaluable. We are honored to work with this remarkable team of international experts that brings together the finest people from science, academia, and industry.

What are your priorities for Terra Quantum as you look to the future?

As I said, quantum computing is going to have a transformative impact on the world – revolutionary, you might say. Our priority going forward will be to remain a leader in the industry. A leader dedicated not only to advancing the technology in the service of science and business, but also ensuring that quantum computing helps society overcome technological limitations and solve problems in eco-friendly, sustainable ways. ●