Title of talk: Using Qubit Automation for Developing the Quantum Supply Chain

Since the demonstration of the first solid-state qubit in 1999 by Professor Nakamura of RIKEN Institute in Japan, the development of Quantum Processing Units (QPU) has been painfully slow. The biggest quantum computer processor announced till date has 256 physical qubits. While this is a major achievement, it falls well short of many millions of qubits needed to build a universal fault tolerant quantum computer.

A key step in the development of QPUs is the need to characterise or understand the behaviour of each individual qubit so that we can learn to control it. Understanding the characteristics of each qubit allows developing protocols to control them and test their quality. Qubits with sufficiently high quality can then be pushed towards entanglement, giving us qubit-pairs. A high quality qubit pair is an important indicator that our development process is on the right track.

The main bottleneck in the rate of development of QPUs is the time it takes to characterise qubits. Current industry benchmarks are in the region of 1-2 days for a single qubit while creating a single 2-qubit pair can take up to a week for a few PhD level experts working together (based on customer interviews and the Company's knowledge of the industry). (https://www.quantum-machines.co/blog/two-qubits-randomized-benchmarking-made-simple/).

This means that to test a QPU properly with 100,000 qubits would take 2,000 years and with a 1,000,000 qubits would take 20,000 years. These are clearly timelines that make development towards useful quantum computers impossible. As QPU development is at a nascent stage and like any nascent technology it will need to go through tens of thousands of iterative development steps before we have useful quantum computers.

To solve this bottleneck there is a need for automotive tools that can dramatically speed up the rate of characterisation and thus speed up QPU development.