

Report on the IOP Quantum Celebration Event

6th June 2023

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Report on the IOP Quantum Celebration Event, 6th June 2023

Following the launch of the UK Government's quantum strategy in March 2023, the Institute of Physics (IOP) hosted a celebratory dinner and roundtable discussion in June, with a group of 18 figures from academia, government, industry and the investment community. As well as marking the achievement of securing a UK quantum strategy with significant and sustained public investment (£2.5bn over 10 years) targeted on important issues for the community, the purpose of the meeting was to consider what actions are now needed for the strategy to be most effective.

Facilitated discussions focused on three topics:

- Research and skills
- Commercialisation and adoption
- International collaboration and regulatory opportunities.

This report captures the key themes within the conversations that ensued and outlines the main insights and sentiments around the room about the necessary next steps for the quantum strategy, the government and the quantum community. These are presented in a concluding section.

Attendees included representatives from:

- House of Lords
- Treasury
- Department of Science, Innovation and Technology (DSIT)
- GCHQ
- National Quantum Technology Programme (NQTP) strategic advisory board
- Innovate UK
- UKQuantum (trade body)
- Quantum Exponential (investors)
- Businesses
- Institute of Physics (IOP)

The event was chaired by Professor Sheila Rowan CBE, IOP President, and facilitated by Anke Lohmann, chair of the IOP's qBIG (Quantum Business Innovation and Growth) group, and supported by IOP's Louis Barson, Director of Science, Innovation and Skills and Anne Crean, Head of Science and Innovation.

Aside from on-the-record introductory remarks, discussions were held under the Chatham House rule. This report paraphrases and summarises what was said. While some comments are

reported verbatim, none are attributed. Comments are individual's views and so, not necessarily those of associated organisations or government policy.

Introduction and context

Over the last year, the UK quantum community has achieved significant success.

The IOP convened discussions, including a roundtable with business leaders and events with stakeholders from industry and academia, which were analysed and published as a report, 'A Vision for Quantum Technologies in the UK', in November 2022.

That report set out views from across the sector about the imperative to support the sector as quantum technology emerges, recognising its unique potential for transformational technological change, and its national strategic importance. It proposed a vision for the UK quantum sector and made 10 recommendations to enable the realisation of this vision. In March 2023, the government announced its national quantum strategy, committing £2.5bn over ten years to support the ongoing development of quantum industries.

The event detailed in this report, in London on 6 June 2023, was held to celebrate this success, acknowledge the important contributions from a range of stakeholders, and consider how best to secure maximum impact for the government's investment. The event reflected the shared ambition across the quantum community to continue to work together to shape the sector.

Welcoming comments

The event was chaired by Professor Sheila Rowan CBE, President of the IOP, who welcomed invited guests and set out the aims for the session. She noted some recent successes in the quantum field which IOP have directly supported included:

- Launch of UKQuantum as trade body for the quantum sector, with launch event at IOP
- Launch of a quantum coding challenge for A level students by Orca Computing and IOP
- High uptake internationally of a new Quantum Journal from IOP Publishing
- Launch of the new qBIG (Quantum Business Innovation and Growth) group within the IOP membership, including large and small businesses involved in commercialising quantum technologies such as BAE Systems, Leonardo, Oxford Instruments, AegiQ, Quantum Dice, Orca Computing, QBA, Airbus and Coherent
- IOP partnership with investors Quantum Exponential to award the first qBIG prize for start-ups, the winner of which – Cerca Magnetics – featured in the Commercialising Quantum summit hosted by the Economist
- IOP's Quantum22 conference attracted 10,000 registrants.

Introductory comments were also made by Rachel Maze of DSIT, who gave an overview of the quantum strategy's four main goals and an update on progress to date. Rachel noted that the

successes of the NQTP were thanks to many of the people in the room, and said the new strategy aims to build on these successes. The government's strategy targets areas that will catalyse the growth of the UK sector in the context of international competition. These include developing a new 10-year quantum R&D programme to replace the NQTP; developing 10-year innovation missions, accelerator programmes and sector action plans to drive technology development and demonstrate value; increasing the economy's readiness for widespread roll out of quantum technologies; funding an additional 1000 postgraduate research students in quantum-relevant disciplines over the next 10 years; and demonstrating international leadership in standards and regulation whilst increase international collaborations and outreach in R&D.

Progress in the first three months since the launch of the strategy has included:

- approximately £100 million of industry-led activity including missions on quantum computing and on quantum position, navigation and timing, plus a quantum catalyst fund to issue contracts for pre-commercial public-sector procurement of quantum technologies and a quantum networks accelerator programme
- A call for £100 million of investment in research including new research hubs across the technologies from computing and networking to sensing and timing
- Starting the DSIT-commissioned Regulatory Horizons Council review into creating a pro-innovation regulatory environment for quantum technologies
- Commissioning a review of infrastructure needs and opportunities for investment in quantum technologies.

Priorities for the coming months include the launch of a skills taskforce and work to shape longer-term missions and accelerator programmes.

Professor Sir Peter Knight, chair of the National Quantum Technology Programme, also spoke briefly about the work of the NQTP, approaching its tenth year in 2024. Its work can be seen as in two five-year phases. The first phase saw the creation of a collaborative environment, building a mechanism for working together for the 'common good' of the sector. The second phase saw increased engagement with industry through a challenge fund. This was difficult work as quantum technology is still emerging and its purposes and full potential are not yet fully understood. But, through the programme, a modest investment from the government leveraged in significant interest from industry. It had succeeded in marrying science in the lab with economic advantage.

Reflecting on the success of the quantum programme to date, Sir Peter argued that the UK is emerging as a science superpower, but it is not yet a commercialisation superpower. An important focus now must be translation. Quantum companies need to feel confident that they can grow in the UK – and the danger for the UK is that if they cannot, they will go overseas. The mission of government must be to make sure that good UK science is not exploited elsewhere.

The UK has shown strong leadership so far, and its quantum sector is well regarded internationally. Relative to other countries it ranks highly for public investment in quantum. But without creating the conditions for private investment it will fall behind in terms of overall investment.

Research and skills

The facilitator began the conversation by asking for people's views on the importance of continuing support for research under the strategy. Much of the focus of the NQTP has been in supporting the creation of start-ups from early-stage research; it is clear that there is a need to support the next stages of development within the strategy. This conversation aimed to address the question of how far the strategy should move in that direction.

There was widespread agreement that the strategy needs to continue to support research, which was described in discussions as a 'no brainer'. There were several arguments made for this:

Much is yet to be discovered.

Research remains vital because there is still so much that is unknown about quantum physics. Our understanding of quantum science will continue to develop as fundamental and applied research progresses, and these in turn will support innovation and product development. The success of the NQTP to date has been to support the creation of start-ups, which remain crucial to the quantum ecosystem; this should not stop with the end of the NQTP.

Research provides a skills pipeline for the sector.

To be sustainable, the sector will need to expand its workforce as it grows. Research into quantum physics enables the development of expertise that equips people to undertake new roles in the sector. However, it was also argued that more could be done to improve people's transition from research into industry. Additional skills in engineering are also needed by businesses. While there were calls for 'professionalisation' within universities in project management, improving lab facilities for research, it was also pointed out that universities are taking on several roles within the ecosystem – research, developing skills, etc., – and that support systems need to be in place to help them to do this.

Fundamental research that asks the 'big questions' is exciting and can capture the imagination of young people.

Further upstream in the skills pipeline is the ongoing challenge to attract enough people into physics. This is a major focus of work by the IOP, particularly with under-represented parts of the population and in schools around the UK and Ireland. It was argued that fundamental research into questions on areas such as dark matter can fire the imagination and inspire people to want to get involved. Questions like these are particularly relevant to quantum, because quantum technology could deliver new tools with the potential to detect dark matter, and better understanding of fundamental issues in quantum science have the potential to resolve some of the great unsolved questions in physics.

Perspectives on the skills shortage

It was noted that the skills shortage problem is not unique to quantum, and one person asked how distinct the skills were. How far do the skills needed for the quantum sector overlap with those needed in, for example, AI? These are questions that the government's quantum skills taskforce will be addressing.

The scale of the UK skills shortage is illustrated by estimates about recent hiring activity. It is thought the UK quantum sector hired more people in the last 12 months than were trained through the NQTP during the last five years.

It was also noted that skills shortages are also not unique to the UK. China and USA are both concerned with their own pipelines.

Historically, much of the translation process from early-stage research through to application happened within large company structures, where the company was also the end-user. Within this structure, individual scientists could see a product through the development process, gaining the required engineering skills along the way. This environment for skills development no longer exists, which highlights the need to find ways to link up SMEs with larger companies.

Employers today, however, could play a greater role in skills development. German companies, for example, invest much more in training than their UK counterparts. One person commented on the need to recruit people who you can look to upskill, rather than waiting for the perfect candidate.

Education and awareness

Some points were raised about the importance of teaching in schools. There is a challenge to think about how to equip teachers to teach about exciting new areas of physics and computing. Examples were cited of work to improve awareness in other fields, including a programme of 'cyber-enablement' and hackathon activities to support children's coding skills.

Another participant recalled their experience of careers advice at school. Their careers advisor had no awareness of what physics could enable them to do, so they opted to study engineering instead. If children don't know what is possible with physics, they won't pursue it. This is something that the IOP are currently looking to support addressing via the [Planet Possibility](#) initiative.

There was general agreement about the need to improve education and understanding of quantum more generally – in schools and other parts of society including the civil service and government.

Commercialisation and adoption

The second broad area of conversation related to later phases of the product development process. While all present agreed that continued support for research and a renewed focus on developing skills to support the sector were important goals for the strategy, the key focus for the strategy is how to support commercialisation – something UK businesses have reported is a significant challenge.

The UK quantum sector has been most successful so far at attracting early-stage investment, and the large number of quantum start-ups reflects this. It has been less successful at encouraging investment in business growth. Currently, foreign venture capital is the most likely source of funding for companies looking to expand, with the British Business Bank not currently occupying this space as actively as it could.

“Beyond series B, UK start-ups have to go to Silicon Valley.”

Within the new strategy, there is a need for active investment in later stages of company development. The UK government could itself be more involved. One suggestion was made that a sovereign wealth fund could take on this kind of role. Another guest argued that ‘hothousing’ of those companies that look most ready to make the jump to commercialisation would be beneficial.

Agile procurement

A key theme in the discussion about commercialisation and adoption was agile procurement, which is viewed as an important enabler for quantum companies. Conversation centred mostly on government procurement and the opportunities that public procurement could provide for young companies.

Government has an important role to play as the first customer for quantum systems. For example, the Ministry of Defence purchased the first quantum computer from a UK company. Beyond the value of the order, this provided significant additional benefits: the purchase gives the company a ‘seal of approval’, and serves as a marker for quality and credibility. It led to some publicity and unlocked further business as four private sector orders followed. For the MOD’s part, as the first buyer it got a competitive price so achieved better value for money.

Attendees explored what is required to enable agile procurement to happen.

Purchaser must accept a degree of risk.

Procurement of a new system, from a small company, requires a mindset that is open to the possibilities but prepared to work with the uncertainties inherent in being first adopters of new technologies. Quantum technology represents a higher risk purchase.

Purchaser needs to understand the technology and its potential.

For similar reasons, the procurer must recognise the potential of quantum systems. It was observed that, within government and the civil service, the level of understanding and awareness of quantum technology is not always high. Greater education and awareness are needed to improve confidence. Also, having a point person within departments supports the relationships between suppliers and procurers. The Office for Quantum could play a useful role in brokering these relationships.

Ongoing relationship needed between purchaser and provider.

Several reasons were given for this. With such a new technology, purchasers cannot wait until the right product comes along. There needs to be an ongoing dialogue between end users and companies.

“It’s really important that we grow up with the industry, learn alongside the development – otherwise if we sit back and wait 10 years, we’re never going to catch up.”

A warning note was also struck about some public sector procurement. For smaller businesses, poor procurement practices can cause problems. If faced with ‘bad customers’, companies will look to other markets.

Role of government in supporting procurement

The existence of the Office for Quantum is an opportunity to encourage procurers across government to invest in quantum. Health and Transport are two areas frequently cited during conversations as having real potential to benefit from quantum technology. These departments could test prototype quantum devices, such as sensors, which could make a big difference to systems. It would require only a modest investment by the standards of government budgets, but could be transformative for services, and would help to grow UK businesses.

The government needs to be aware of the risks of failure to invest in this way: if UK companies are not supported, they will be bought out by overseas venture capital, and sovereign capacity will be lost.

Ensuring good levels of understanding within government of quantum’s potential and government’s strategic role is important for enabling agile procurement. To encourage interest, the sector needs to explain to decision-makers the policy challenges quantum technology is going to help address. Ongoing relationships between companies and departments may help – though given the number of small companies, this presents practical challenges, so a representative voice would be valuable.

Links between SMEs and large businesses

The other market for most UK quantum SMEs is large multinational businesses, which are starting to do deals with SMEs for specialist equipment. An example was given of a small Bristol company, QLM, which sold devices to Schlumberger. Examples like this should be publicised and celebrated.

One observer commented that US and German companies are quicker to work with SMEs than their UK counterparts. Large UK companies appear to be ‘waiting and seeing’. Despite commitments from government, they have not yet engaged with the quantum strategy.

“It is notable there is lots of government money on the table but industry is not all over this.”

The government may be able to incentivise larger companies to buy from UK quantum companies. There is also a need to facilitate links between large enterprises and SMEs, so that SMEs are better aware of what big companies need. It was suggested that investors could play a part in supporting this process.

Inward investment

It was felt that the UK quantum sector has significant potential for inward investment. The UK has historically been good at attracting inward investment, but it has not seen similar success with quantum technology.

The example was given of Toshiba in Cambridge. Toshiba made its largest investment outside of Japan for a facility close to Cambridge, which was attractive for its intellectual resources. Various guests also noted that Cambridge had been championed very effectively (by Dr Andrew Shields of Toshiba, recent winner of the IOP Katharine Burr Blodgett medal and prize).

It was felt that the Toshiba example is unusual and should be shown as an exemplar of what can be achieved within the UK quantum sector.

It was argued that the UK can be ‘too polite’ when talking with businesses about locating facilities here. There is a need to be more bullish in engaging with big companies to invest, by emphasising the UK’s advantages, such as its very strong university research base.

Another argument was that we don’t need to be ‘starstruck’ by big companies. The UK sector can succeed with large numbers of smaller companies – as the success of the UK photonics sector shows. However, a challenge many SMEs face is establishing connections with other countries.

One speaker suggested that the UK could leverage its strategic alliances to support its enterprises – for instance by facilitating links with NATO partners.

Locating businesses in the UK

Various points were made relating to the UK's attractiveness as a location for businesses.

The UK is currently seen as attractive for small organisations, since grant funding is relatively easy to access. However, other countries are throwing money at companies to locate there; this can be hard to resist for start-ups which need cash.

The term 'quantum refugee' was used to describe businesses (and people) that might choose the UK for their operations. US export regulation is currently acting as a push factor for organisations that need to access certain markets (specifically China). The UK's own export regulation should avoid creating a similar obstacle for companies.

Visa regulation was also discussed, with several people commenting that regulation could be more open. An example was given of a joint UK-French initiative that British companies are unable to exploit because of visa issues.

These issues are relevant to core government industrial strategy, not just quantum.

International collaboration and regulatory opportunities

The subject of inward investment brought the group's discussion into its third key area of international collaboration and regulatory opportunities.

In this final section, guests discussed the need for the quantum strategy to inform government policy in a range of areas that have an impact on the trading environment for quantum businesses, including export and visa regulation, and standards. The UK's relationships with other countries are also important for the quantum sector because of the likely impact of quantum technology on defence and security.

The countries with whom collaboration on quantum seems most likely are those with alignment on values and capabilities. Key opportunities were identified as lying with the US, Canada, Australia and the Netherlands.

Standards

One important part of securing international cooperation is agreement on standards. It was pointed out that UK involvement in setting international standards has often been by volunteers – it was argued that this could be professionalised to better represent the interests of UK quantum companies. Even with this, challenges remain. Standards for quantum are likely to be difficult to define, and there would need to be some targeting of key partner countries with whom to agree standards.

Strategic relationships

The UK has several key strategic relationships with other states which could be leveraged for the benefit of the quantum sector. Active management of relationships should be used to resolve issues such as supply chain problems.

Some participants expressed concern about Europe. European engagement is causing problems at the moment. UK companies' ability to export back to the UK was described as 'in deadlock'. An example was given of a system jointly developed with France which UK teams cannot access because of visa regulations for staff. It was suggested that there should be a major initiative to re-engage the relationship with Europe.

Export regulation

Beyond the UK's strategic partnerships, the quantum sector may be impacted by trade restrictions with other countries. During the discussion, reference was made to difficulties exporting components and quantum technologies, and views were expressed that it is important to make sure that exports and other controls don't hinder the growth of the sector.

Quantum's role in UK security

With regard to international considerations, government needs to realise the significance of quantum technology to the UK's economy and future security.

Quantum technology could provide a much stronger underpinning for the UK economy. For example, the UK is highly reliant on the global navigation satellite system, which is fragile. Investment in technologies that can remove this dependency and build resilience would be highly valuable. Attendees at the celebration event expressed concern that the government is not fully aware of this.

Conclusions and proposed next steps

The conversations at the IOP's celebratory event were wide-ranging and took in a variety of perspectives from government and the civil service, investors, industry and academia.

While there were some points of nuance and differences in opinion, some very clear messages emerged about how the government's strategy could progress for maximum impact, and what the next steps should be for delivering support to the quantum sector.

There was widely shared excitement about the possibilities of quantum and its impact. The scale and long-termism of the government's commitment to quantum (£2.5bn over ten years) was

noted as being exceptional. The Office for Quantum is currently highly engaged in setting out its missions for the strategy and this was recognised as important work.

Throughout the conversation, various additional suggestions were made for next steps from government.

It was proposed that the **Autumn Statement** could be used to re-emphasise the importance of quantum. The speech provides an opportunity to raise the profile of the sector, even if no new financial announcements are made. One person asked whether introducing a '**Minister for Quantum**' could give the sector higher profile.

Another speaker proposed a '**quantum Longitude prize**' to incentivise innovative ideas to address a particular problem. Emulating the public challenge model first used to improve nautical navigation in the 18th century and now employed by Nesta to address health questions, such an approach would support the development of an innovation that could be transformational, while engaging a wider audience and growing interest in the sector.

Developing a communications strategy

A number of arguments were put forward in favour of a communications strategy to support the quantum sector.

Developing the voice of quantum.

Running through all the discussions was a strong agreement about the need for the quantum sector to have a stronger voice.

The photonics sector provides a useful illustration of why. It makes a very large contribution to UK GDP (c. £14bn a year) – higher than pharmaceuticals. 75% of its product is exported, and the sector never grows by less than 5% per year. But the sector is divided into 1600 companies and has no truly big players. As a result, it doesn't have the same clout as other sectors.

Educating and exciting leaders.

Understanding across government about quantum is limited. The general view was that we need to show how quantum is relevant to government and parliamentarians who are thinking about the challenges they face now. Thinking is also largely focused on quantum computing, and so it is also important to show the relevance of quantum imaging, sensing, timing, navigation, metrology, communication and secure encryption technologies across diverse sectors - from medical, healthcare, defence and national security, to autonomous vehicles/transport, environmental monitoring and finance.

For the national quantum strategy to succeed and for the UK to benefit fully from a strong quantum sector, there needs to be buy-in at the highest levels of government. While government

has already committed to spend large sums to support quantum, the money needs to act as a catalyst for further action.

Improving understanding of quantum.

During the discussion early in the evening about improving the skills pipeline, wider public awareness of quantum was proposed as an important step.

Heading off future challenges.

One speaker pointed to the danger of a ‘hype loop’, in which, following the major investment announced by government, any perceived failure to meet expectations quickly enough could lead to calls for reduced investment in future. The investment therefore creates pressure for the quantum strategy to be seen to deliver results.

Additionally, we are seeing with AI now that innovation can be frightening and provoke popular backlash. For the quantum sector it is worth ‘leaning into this’ to prevent similar issues surfacing in future.

Supporting communications across the quantum community.

While there was a lot of emphasis on government action, it was pointed out that the wider quantum community also has a role. It is not only the government’s job to communicate about quantum. The next ten years should be seen ‘as an opportunity to tell our story’.

There will be significant opportunities around the 100-year anniversary of the first quantum paper, which will be celebrated in 2025. This is predicted to bring widespread international attention to quantum theory and its applications.

The existence of the quantum strategy was noted as being useful in itself as an advocacy tool. Beyond this, however, a ‘sales pack’ for UK quantum would be helpful, providing information to support advocacy for the sector – to raise awareness of the UK’s strengths internationally, and raise awareness of the transformative potential of quantum more widely within the UK.

An important part of the messaging should be that quantum technology is not limited to quantum computing. There is a much broader range to the sector. Engagement and understanding are too often just about quantum computing.

Messaging should also focus on increasing awareness of issues that quantum can solve – and specifically placing them in a political context so that parliamentarians can see how it relates to the challenges they face.

To influence business, there needs to be a clear value proposition – in numbers – showing business what they can get out for a given spend. Government has a role to help obtain this

information from UK companies. It was noted that a value proposition is easier to set out for commercial entities than strategic projects.

Cross-government working

Another consistent message throughout the various topics discussed was about how government must work differently to support its quantum strategy. As well as seeing an impressive amount of money spent by government to support the quantum sector, the quantum strategy should be a catalyst for change in the way government thinks about quantum technology.

The quantum strategy should influence activity and policy across different parts of government, in particular:

- public sector procurement, including defence, health and transport
- trade and visa regulation.

Adapting approaches to these areas of activity would bring significant opportunities for the UK quantum sector, though their impact would extend into other parts of the economy.

The quantum community

A final theme from the event was the strong sense of community and shared endeavour around quantum, from across the stakeholders represented. Attendees consistently reported on the value of a shared vision for the sector, and the successes that collaboration has had so far.

The meeting was positive, and people affirmed their support for the implementation of the quantum strategy. As one attendee noted, “There are no whingers here”. After the event, a second commented:

“I think we made a number of promises to each other as a community as to how we take the strategy and our ambitions forward quickly and as a collective.”