

multicore processors, hyperthreading and the use of massively parallel architecture. Unfortunately much of industry uses legacy systems that have been developed over many years. The UK software business (worth over £3bn per annum) faces the huge challenge that almost *all* software will need to change to reflect the new architectures. Research and skills are crucial to these changes, and worldwide investment is urgently required.

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Inevitably, there are natural limits to what can be achieved. Nothing can grow exponentially forever, and we are already facing barriers imposed by basic physics. Transistors will soon have to be produced on a quantum scale and be just a few atoms large; circuit etching is limited by the 50nm wavelength of UV light, and hitherto unforeseen quantum complications such as the Heisenberg uncertainty principle

and electron leakage from wires will have to be dealt with. The challenges are truly enormous.

“TECHNOLOGICAL SINGULARITY” – THE KRAKEN WAKES

Finally, it is worth debating whether computers will ever become “conscious”. As humans we set great store by the fact that we are conscious, living beings – but what are the essential differences between our brains and a computer? Could it be that

we are no more than extremely sophisticated robots? Many have debated this exotic question without coming to a conclusion. Nevertheless, eminent computer scientists regularly discuss so-called “Technological Singularity” theory, which countenances the possibility that, at some time in the near future, superhumanly intelligent computers that are in some sense “awake” will develop. Further, large computer networks and their associated users may combine to become

an intimate and sentient, superhumanly intelligent entity. One result of this could be that biological science finds ways to improve on the natural human intellect. Some aspects of Technological Singularity theory are rather scary. Some of its exponents refer to the “post-human” era. It has been noted that there is no reason why a conscious, superhumanly intelligent computer should be friendly to humankind. Serious scientists across the world believe that it is only a matter of time before the singularity occurs.

CONCLUSIONS

For many years Moore’s law and increased miniaturisation have combined to guarantee that computer speed and capacity increase. However, the days of the improvement via hardware are drawing to a close. We still need investment in supercomputer hardware and data centres, but even more we need investment in research, infrastructure & skills, and software development. The future is still rosy, but the

strategic plan forward is becoming ever more complicated and the stakes could not be higher.

SPEED

National Science and Engineering Week Seminar on Thursday 21st March

We also heard from Lord Drayson (a previous Minister for Science) about his development of superfast electric cars. This included a film of him accelerating from 0-100mph in just over 3 seconds!

The final talk was from Professor Steve Jones (UCL), the well known geneticist and writer. He gave an amusing account about the rates of migration of snails (and hence their genes), and then segued into human populations, and in particular the surname “Jones”.

AN OASIS IN THE DESERT – The growth of a Science Base in Qatar



Dominic McAllister
UK Science & Innovation Network
(Gulf)

The UK Science & Innovation Network has recently appointed an officer to cover the Middle East Gulf region. Based at the British Embassy in Doha, Dominic McAllister covers UK S&I links with Qatar, Saudi Arabia, United Arab Emirates, Kuwait, Oman and Bahrain. He writes about his early experiences of Qatar. You can follow him on twitter @UKScienceQatar.

Coming to a new posting in the Middle East after three years in Seoul has been a big shift for my family. We aren’t new to the region – my daughters are proud of the fact they were born in Riyadh. We had some

expectations, but returning after 15 years has been an education. The rate of modernisation in Doha was the first revelation. A forward looking royal family, a relatively cohesive society, and a steady investment of income

from gas and oil reserves are principally responsible. Doha is literally emerging from the desert (in many places the pavements are still sand). The traditional souk has been rebuilt, but is now air-conditioned. The



peaceful waterfront Corniche provides an escape for families at weekends.

A second revelation was the impact of modernisation on a culturally conservative population. The Qataris are a minority in their own country. Estimates suggest they are 300,000 from a total of 1.9 million. Doha is an expatriate city with all the conveniences of a Western society. Modernisation has affected the Qatari population in both positive and negative ways: easier access to higher education is leading to new employment opportunities for women; changing diets and the advent of fast food have resulted in growing obesity levels – Gulf States have some of the highest levels of diabetes and other metabolic diseases (genetic factors also play a part); fast cars and an array of driving styles result in one of the highest levels of road deaths; and lack of Arabic sources of information on the internet and in the media is leading to a decline in the use of Arabic in the Qatari home. The challenge for Qatar's leaders will be to modernise while maintaining a Qatari identity. They have a lot of ambition. Qatar will host the World Cup in 2022 and is bidding to host the Olympic Games in 2024. Over the next ten years Qatar will invest up to £147 billion in new infrastructure including sports stadia, a metro system, new roads, and new utilities (electricity, water, ICT).

Qatar also plans to invest 2.8% of its expanding government budget on research. It wants to diversify from its oil and gas industry base and sees investment in science and technology as key to the development of a knowledge economy. The biggest challenge remains the size of Qatar's human capital. Tertiary education uptakes are low and those pursuing science-based degrees

outside engineering are a minority. Qatari women dominate research, but often have cultural restriction on travelling and studying overseas. The domestic science base will always be small, but is conveniently concentrated around Doha which presents an opportunity to develop a streamlined science, technology and innovation sector.

The research environment divides between a traditional centre based at the segregated Qatar University and a modern centre based around the co-educational international branch campuses at Education City which is home to the Qatar Foundation (QF). Qatar University has expanded research into: environmental studies (ESC), gas processing (GPC) and advanced materials (CAM). Education City hosts international branch campuses from UCL, HEC Paris, Georgetown, Carnegie Mellon, Weill Cornell Medical, Northwestern, Texas A&M, and Virginia Commonwealth. These focus on undergraduate training (except UCL), but are keen to develop postgraduate courses to support research. QF is currently launching the Hamad bin Khalifa University which will provide postgraduate training and research in partnership with European and US partners. Education City hosts a number of research centres focusing on: environment and energy (QEERI), ICT (QCRI), biotechnology (QBRI) and cardiovascular medicine (QCRC). It hosts the Qatar Science and Technology Park (QSTP) and will be the home of the new SIDRA Research and Medical Centre.

R&D investment to date has lacked an over-arching plan, but this is changing. In October 2012 Qatar launched its R&D strategy in four key areas; energy & the environment, healthcare, ICT, and social sciences & humanities. Qatar is

keen to solicit UK advice to ensure research funds are spent wisely and to show the Qatari people the value of this investment.

UK/Qatar research interests are strong and are set to expand. David Willetts visited Qatar and UAE in March and agreed plans to establish high level education and research dialogues. The UK Government is looking to develop a range of research partnerships linking UK research strengths to Qatari and UAE development needs. In Qatar Imperial College has a research partnership through its Carbonates and Carbon Storage Research Centre on QSTP (£47 million over 10 years) – this is Imperial's largest overseas investment. It is also a partner in the Qatar Biobank Pilot Project at the Hamad Medical Corporation (£6 million over 3 years), a robotic surgery centre, a stroke repository, and a cardiovascular research centre. Imperial has links with the new SIDRA Research and Medical Centre. The British Library has signed a £8.7 million Gulf-archive project with the Qatar National Library to digitise and catalogue BL records of the region and to carry out conservation research.

The UK has a good record (second only to the US) in attracting grants from the Qatar National Research Fund (QNRF) National Priorities Programme in partnership with local research centres. In April two UK/Qatar research projects – to expand the Qatar Exoplanet Survey and to help manage the weight of Qatari school children – won QNRF exceptional funding worth £3.85 million. In its five years of operation 43 UK institutions have linked up with Qatari partners to secure 47 QNRF grants worth up to \$1 million each over 3 years. Up to 35% of this grant can be spent in the UK. A number of UK institutions are bidding into the sixth round

of the Programme, the result of which will be announced shortly.

Qatar's infrastructure development also provides an innovation platform for new technologies. This week BHR Group are leading a water technology mission to Doha composed of SMEs with expertise in telemetry, pressure management, leak detection and water quality that can augment existing water supply systems. Their objective is to get innovation specified in the tender documents for new water supply projects. The Embassy is also pursuing similar technology initiatives in green construction, rail and food security. Qatar scores highly on a range of business indicators (stability, effective government, relative absence of corruption and a booming economy) making it a good destination for R&D investment. Doha is also fast becoming an ICT hub.

Qatar is keen to associate new science investment to an Arab Scientific heritage with its links to Western enlightenment. The Doha Museum of Islamic Arts has been working with UK partners to stage exhibitions: 1001 Inventions – The Enduring Legacy of Muslim Civilisation (Shell) and Arabik Roots (Royal Society). Astronomy has strong Arabic links. Lord Rees, Astronomer Royal, visited Doha in February to give the keynote speech at the 1st Doha International Astronomy Conference jointly organised with St Andrews University and Qatar has announced plans to set up a space museum.

Prospects for closer UK/Qatar and UK/Gulf R&D collaboration look bright. The challenge for SIN Gulf, the Embassy, the British Council and others will be to raise awareness among UK stakeholders of this significant opportunity.