

Reflections and Vision

The Newton Gateway to Mathematics

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mathematics
& its applications

Disclaimer

This talk does not represent the view of the Institute of Mathematics and its Applications, or any of the other bodies mentioned.



Gateway to Mathematics

The Newton Gateway to Mathematics acts as a vehicle for knowledge exchange between the mathematical sciences and potential users of mathematics, including industry, government, business and other academic disciplines, both in the UK and internationally. It does this by facilitating interactions and activities such as programmes of work, research and training events, as well as bespoke projects. The Newton Gateway to Mathematics aims to widen access to mathematics generally, to shorten pathways to impacts for academic research, and to support education and training in areas where mathematical skills are needed.

Knowledge Exchange: Why and How

- Why do we do KE?
- How do we do KE?



Why KE?

- To solve existing or emerging problems in industry, business, services, policy;
- To support and develop other areas of research and development;
- To prepare for and co-create future applications;
- To enrich and energise the mathematical sciences.



How?

We need to talk about

- Maturity
- Time
- Mechanism
- Position
- Style
- Dissemination



The KE pyramid

A view of “the knowledge exchange pyramid”:

The base

- A broad range of applications of existing mathematical knowledge to problems which are reasonably well-posed and well-understood. The questions and answers are bounded in scope and time. This is the domain of mathematically qualified practitioners (possibly badged as mathematicians, statisticians, engineers) in business, government and so on, of undergraduate student exercises, projects and placements, and of ad hoc short-term consultancies.



The KE pyramid

The middle layer

- Development and extension of known areas, or the expert selection of appropriate techniques to problems exhibiting some degree of novelty. Problems are not well-posed or well-understood, scoping exercises and selection of appropriate team expertise is required. This is the domain of professional mathematicians working in application areas, M.Sc. or Ph.D. projects, long-term consultancy and research relationships between research groups and customers.



The KE pyramid

The summit

- Research and development of novel mathematical techniques or areas. The problems are grand challenges, horizon scanning or research foresight, with variable time and scope, requiring significant effort even to delineate and assess. This is the domain of intra- and inter-disciplinary research groups, extended collaborations, research institutes and national infrastructure.



Quantum Computing

In 1995, CESG, the precursor of the National Cyber-Security Centre (NCSC), started tracking Quantum Computing as an emerging technology to understand its effects on cryptographic security protocols. It established a small academic programme in collaboration with Oxford University and the Royal Society. Around 2004, CESG had an internal research programme in post-quantum cryptography in partnership with the new Heilbronn Institute.



SOLILOQUY

SOLILOQUY was a fully developed cryptographic proposal based on lattice problems believed to be intractable by both classical and quantum algorithms.

Surprisingly, CESG/HIMR researchers found a new quantum algorithm which solves the underlying lattice problem in what was thought to be polynomial time — thus rendering SOLILOQUY unusable.



PQR at TGM

The SOLILOQUY story made it clear that it was not possible for CESG/NCSC and/or HIMR to compete head-on with the rest of the world. It was decided to turn previous strategy inside-out and to publish the SOLILOQUY research in order to stimulate academic research and development and for NCSC to work with partners in academia and industry.

GCHQ as parent body decided to partner with TGM as the right forum to find key partners and disseminate its work most effectively to multiple audiences.

GCHQ and TGM

GCHQ sponsored two successful workshops at TGM on Post-Quantum Cryptography and achieved its objectives in developing the partnerships it wanted, within a broader framework of NCSC collaboration with academia.

GCHQ has also sponsored a horizon-scanning workshop on Novel Computational Paradigms in 2018 which has also achieved its objectives.



Predictions

We live in exciting times.

The Bond Review has challenged the mathematics and KE communities to make the case for knowledge exchange in the mathematical sciences to increase in effectiveness, scope and, dramatically, in scale.

The Knowledge Exchange Framework will determine how KE is assessed and rewarded: the mathematical sciences need to ensure that their needs are adequately represented in that framework.

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Partnerships

The Newton Institute and Newton Gateway do not work in isolation.

The Newton Gateway must continue to broaden and deepen its range of partnerships, and especially to establish its role as feeding into the mathematical research agenda.

The IMA has expressed the intention to form a strategic partnership with NGM.

Pragmatics

Resources — money, people and time — will be needed to realise these benefits. The case can be, and has been made, and will need to be repeated and reinforced, for investment in the Newton Gateway as a key part of the national KE network.



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Best wishes to the Newton Gateway in the next phase of its mission



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