

UK mathematical sciences research infrastructure – helping to join the dots

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MS Infrastructure Review

- **EPSRC Mathematical Sciences (MS) Strategic Advisory Team (SAT) initiated review of MS Infrastructure in 2014/5**
- **Looked at activity supported by EPSRC:**
 - **Isaac Newton Institute**
 - **International Centre for Mathematical Sciences**
 - **Durham Symposia**
 - **Warwick Symposium**
- **+ European Study Groups with Industry**
- **Extensive online surveys and responses**
- **Subset of SAT analysed data and wrote report**

MS Infrastructure Review

- **Findings and recommendations:**
 - **MS Research Infrastructure is important to UK Mathematics**
 - **ICMS and INI offered excellent value for money, wide reach and international reputation, high quality programmes of work**
 - **Could improve support for the talent pipeline and early career researchers**
 - **Should improve diversity in participation, [... the then female participation rate was 16%]**
 - **Longer and shorter term programmes needs to be considered and effectively managed at the UK level**

Outcome of Review

- MS Infrastructure call in 2016 just for INI and ICMS
- Protracted process of submission and assessment over 1 year!
- Awards announced November 2017 with INI start 1st March, ICMS 1st April 2018
- New awards offer increased funding over previous grants but not as much as we would have liked. To achieve some of our goals we need to find creative ways to manage budgets
- Grants run for 6 years offer stability and strategic planning

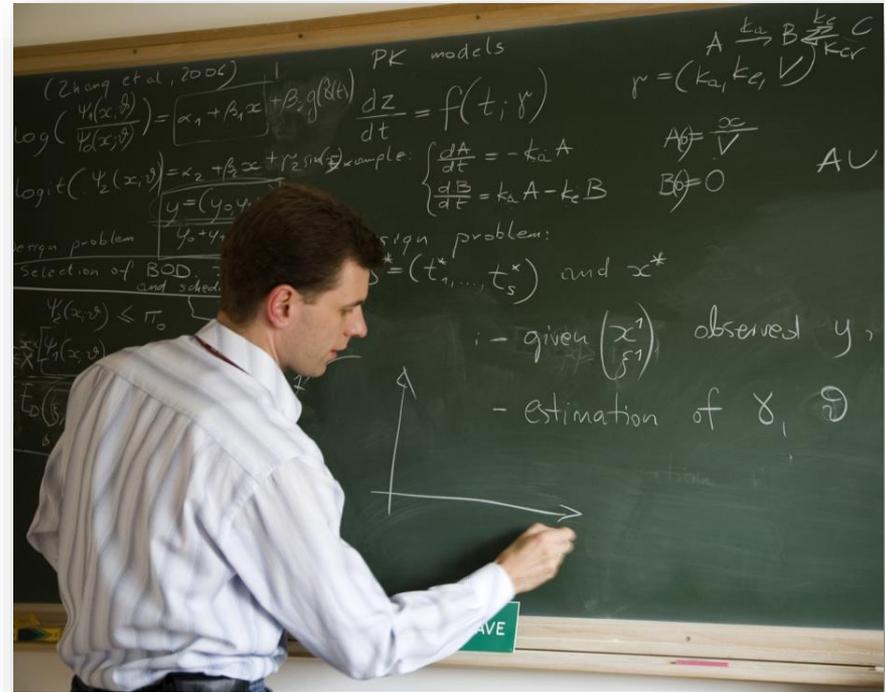
Purpose of this talk is to ask:

“WHAT DO YOU WANT FROM UK MS INFRASTRUCTURE AND HOW CAN IT BETTER SERVE THE COMMUNITY?”

Summary of what INI does ... but first ...

Quality above all else

- Very rigorous refereeing and assessment processes
- High quality leadership, participation and structure
- The best people always come!
- Excellent support staff
- Intra and Interdisciplinary
- At the forefront of current developments
- Aimed at breakthroughs rather than consolidation



Isaac Newton Institute

- Established to be the UK's national mathematics research institute
- Located at Cambridge University, following a national competition
- Opened in July 1992
- Acknowledged as a global leader in pure and applied mathematical research
- Ambitious plans in train to expand its space



What does INI do?

INI changes lives and moves disciplines!

Typical feedback:

“The Isaac Newton Institute is a singularity in the research landscape - scientists from the whole world meet and push the frontiers of science.”

and

“I am a huge fan of the Institute and believe it is the best of its kind anywhere in the world. I have attended programs at many institutes of this type all over the U.S. and Europe and truly believe you are quite distinct and very special.”

Activity and Scale



Terry Tao: Fields medalist and participant on INI programmes in 2005, 2011 and 2015.



Dijkstra Prize winner Cynthia Dwork who participated in 2016

- INI facilitates collaborative research on problems drawn from all mathematical sciences and beyond
- Research is conducted through structured programmes lasting typically 4 or 6 months (some 1 month) with ~30 participants in each at any time
- 140 research programmes to date
- Participants include 27 Fields Medalists, 13 Nobel Laureates, 12 Abel Prize winners, 25 Wolf Prize winners and over 50 Clay Senior Scholars
- 1/3 UK; 1/3 Europe; 1/3 RoW
- ~23% of attendees were women in 2017
- ~20,000 programme participant days per year
- ~7,000 workshop participant days per year
- Some 2500 visitors through INI's doors each year

Turing (Newton) Gateway

- The Turing Gateway to Mathematics (TGM) was set up in 2013 to facilitate knowledge exchange at INI
- Links the mathematical sciences community to other disciplines and those outside academe
- An array of supporting mechanisms



Exemplar recent events:

- Environmental modelling in industry study group
- Algorithmic Trading: Perspectives from Mathematical Modelling
- Algorithms and Software for Quantum Computers



Defining moments

- Andrew Wiles announces his proof of Fermat's last theorem
- Stephen Hawking and Roger Penrose debate fundamental ideas on gravity
- David Kitchin QC and other leading law-makers participate on Maths in Forensic Science programme
- Thomas Hales announces automated verification of proof of 300 year old Kepler conjecture



Andrew Wiles



Stephen Hawking and
Roger Penrose



Charles
Simonyi

Future Programmes

Homotopy harnessing higher structures	2018
Scaling limits, rough paths, quantum field theory	2018
The mathematical design of new materials	2019
Approximation, sampling and compression in data science	2019
The mathematics of energy systems	2019
The fickle heart	2019
Bringing pure and applied analysis together via the Wiener-Hopf technique, its generalisations and applications	2019
Geometry, compatibility and structure preservation in computational differential equations	2019
Complex Analysis: Techniques, Applications and Computations	2019
K-Theory, Algebraic Cycles and Motivic Homotopy Theory	2020
Groups, representations and applications: new perspectives	2020

How to be involved

- **Look on website - “drop by” for a day or two without invitation. If longer contact the organisers for an invitation**
- **If nothing of interest to you or your colleagues then put in a proposal to run a short or long programme!**
- **Attend a workshop**
- **Knowledge exchange – contact the Turing Gateway to Mathematics and see what they can do to help**
- **Watch live-streamed talks or open-access digital library of many terabytes of seminars and lectures**
- **Invite an overseas participant to your institution (> 100 visits pa)**
- **Attend (or run) a satellite workshop near**
- **Early Career Membership scheme**
- **Mailing list, twitter, facebook**

ICMS

- Runs a programme of week-long workshops
- As for INI, topics cover the whole of the MS and beyond
- Follow-on/scoping events
- Knowledge exchange events within workshops and as stand-alone activity
- Research in Groups & Research Partnerships with Industry
- Strategic workshops (fast track – two in industrial mathematics)
- Public Engagement
- Other work to serve community such as journals handling

INI/ICMS future

- **Must strive to improve gender balance and diversity**
- **Want to better connect with, and serve, the community and ensure that everyone who wants to ‘use’ ICMS and INI can do so (as long as quality threshold met)**
- **ICMS – exciting new building**
- **INI - ambitious expansion plans to increase long-term participant spaces to >80, and build new lecture theatre**
- **Need to be agile and flexible – and encourage ‘adventure’**
- **TGM to play a bigger/more integrated role within INI**
- **Continue to increase our interdisciplinary, knowledge exchange and public engagement activities**

Joining the dots!

INI and ICMS can and should be more than just venues for research programmes and workshops.

As independent resources supported by EPSRC to serve whole community we can act on matters such as

- **Gender and Equality**
- **People pipeline + Early career researchers (ECRs)**
- **UKRI policy, direction and challenges**
- **Working with the learned societies, government and policy makers**
- **Industrial engagement**
- **Interdisciplinary activity**
- **Connecting MS to others**

Equality, Diversity and Inclusivity

At our recent Correspondents meeting we raised the question of achieving gender parity:

- Rapid recent rise in % female attendees 13->16->19->23
- Pressure on organisers – but should targets be mandatory?
- ECRs - % higher, senior staff - % low
- Rothschild % very poor - introducing new visiting fellow scheme with recent endowment
- Enhance fund for family care
- Unconscious bias training for staff and organisers
- Role out training to all visitors?
- Women in maths/data science/materials etc. now a regular fixture in our calendar

Equality, Diversity and Inclusivity

- Improved accessibility of INI and its accommodation
 - new arrangements and funding for participants with minor to extensive care needs
- New fund for INI workshops – participation of people from the DAC List of ODA Recipient Countries

But can we help change the culture nationally through our efforts?

- >750 UK participants through INI doors per annum
(REF 2014 - 2000 FTE staff submitted in MS)
- The many academic organisers of our events have to consider all aspects of EDI carefully in their proposals

People pipeline

- We don't do much at UG level or below. More (cf. MSRI)?
- PhD training activity is increasing [modelling camps, study groups, industry clubs, retreats, summer schools, supervision training, ...] – should INI have an increasing role with CDTs?
- ECR events including training for new lecturers (HoDoMS/IMA/LMS/RSS)
- Promotion and engagement to aid student recruitment
- Visitors give general lectures for the public
- New Scientist Live 2017



Early Career Researchers

- INI mailing list – receive information etc.
- Now treated generously by programme organisers
- Training courses (TGM and others)
- New funding pot to support more ECRs at workshops
- Considering how to exploit the recorded lectures – turn these into courses with hypertext support materials
- Assist in training on mathematics communication and outreach

UKRI

- **UKRI offers great opportunities as well as threats**
- **shift from capability-led to challenge-led funding**
- **Far more oriented to cross-disciplinary research**
- **Impact integrated into the research**

- **Under research**
 - **Global Challenges Research Fund**
 - **Cross-organisational themes and programmes**
 - **International**
 - **Industrial Strategy Challenge Fund**

- **Under Innovation**
 - **ISCF**
 - **Working with Business**
 - **Excellence with impact**

UKRI

- How do the mathematical sciences respond?
- To date we have been remarkably unsuccessful at applying to or winning ISCF and/or GCRF funds
- Larger funding pots so collaborative/cross-disciplinary projects needed
- Can we run sandpits/scoping workshops/programmes to assist community?
- Share our resources (maths in healthcare, KE expert training, ...)?
- Assist in dialogue?
- Can we fight for, coordinate (and even manage) special calls?

Engaging with learned societies

- **Example of successful interaction:**
 - Global Challenges Research Fund**
 - **Lobbying by CMS and others about the lack of success of mathematicians in engaging with GCRF**
 - **CMS offered funds from EPSRC for a pilot project**
 - **ICMS/INI 'subcontracted' to run the event**
 - **Successful workshop ran at end of February**
 - **Next steps**
- **Joint meetings**
- **Use of INI/ICMS space for CMS/society events**
- **Collaboration on industrial meetings**
- **NSL and other popular events**
- **Lobbying, position papers**
- **Activity on government and policy issues**

Industrial Engagement

- TGM connected to 700 industrial partners – has a clear set of routes of engagement. Help with Impact for REF?
- Changing face of where/how research is prosecuted – eg Google/Amazon/Microsoft
 - what should be the new relationship between business and academia [warning - Cambridge Analytica...]?
 - how can we help this transformation?
- Industrial Strategy Challenge Fund – how to be in the vanguard of new calls?
- Work with intermediaries - Smith Institute, Catapults, KTN
- Bond Review – 26th April launch at House of Lords
 - case for significant increase in funds to assist in ensuring impact of MS research. What role INI/ICMS in this?

Interdisciplinary and PE Interactions

- Collaborations with ATI, Royce Institute, NGI
- Act as a link between MS community and other communities via INI programmes or scoping workshops
- Collaboration with others such NERC and British Antarctic Survey - new model programme with NERC in 2019
- Team effort for UK MS to rise to some of the grand challenges – quantum and post quantum computing, understanding deep learning and AI, computer verification and big proof ...
- Help to improve understanding of MS – Public engagement and outreach. Need to connect the plethora of people and bodies together - what role for INI/ICMS to achieve this?

Other agencies and mathematics partners

- Heilbronn
- Clay
- Bath IMI ...

- ERCOM, EMS
- MSRI
- Fields Institute ...

- Collaboration with Royal Society and better dissemination of information about their schemes, eg
 - enhanced industry fellows scheme
 - entrepreneur in residence

- Charities