Newton Gateway to Mathematics

Annual Report
2019-2020

UNIVERSITY OF CAMBRIDGE

Isaac Newton Institute for Mathematical Sciences

Mission Statement

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.

What Makes the Newton Gateway to Mathematics Different?

The Newton Gateway to Mathematics is a knowledge intermediary for the mathematical sciences. Although based at the *Isaac Newton Institute for Mathematical Sciences (INI)* and supported by the *University of Cambridge*, the Newton Gateway is an independent body serving the whole of the UK mathematical sciences community and reaches out to and engages with all users of mathematics – in industry, business, public sector and other scientific disciplines. With extensive access to multiple communities across the UK and globally, the Gateway can respond in an agile and flexible manner. It works as a delivery partner to facilitate the exchange, translation and dissemination of knowledge. Using effective communications and proven methodologies, the Gateway develops and runs activities such as workshops and meetings, bringing people and organisations together in order to share knowledge and stimulate further research and collaboration.

Engaging with Users of Mathematics

The Newton Gateway to Mathematics is the impact initiative of the *Isaac Newton Institute for Mathematical Sciences (INI)* based at the University of Cambridge. It works with the whole of UK mathematical sciences community to extend the reach and highlight the importance of mathematics to all potential users such as other academic disciplines and researchers in business/industry and the public sector. User engagement is therefore a key focus, helping to understand the community and end-users in order to collaborate effectively.

The Gateway to Mathematics delivers a range of activities, such as research scoping workshops and knowledge dissemination events across a number of different themes and sectors including biology and healthcare systems, environment and energy, financial risk, security sectors, Big Data and public policy.

Gateway activities have expanded, with continued emphasis on partnership and collaboration with other organisations, which is a more effective way of engaging with a wider group of stakeholders, helping to reduce duplication. Since March 2020 in response to the COVID-19 pandemic, activity has been delivered virtually and the Gateway has explored a number of different technologies to realise this.

The Gateway continues in the delivery of the *Edwards Symposium Series* working with the *Edwards Centre for Soft Matter* at Cambridge and supported by *Unilever*. Since 2016, the Gateway has been the user engagement partner for the *Cantab Capital Institute for the Mathematics of Information (CCIMI)* and the *EPSRC Centre for Mathematical Imaging in Healthcare (CMIH)*. These partnerships result in the organisation and running of a number of series of events as well as promotion of collaborative opportunities across an expanding community.

From early 2018, the Newton Gateway has worked on the development and delivery of a programme of work *Evidence Based Decisions for UK Landscapes* for the *Natural Environment Research Council (NERC)* and the *Department for Environment, Food & Rural Affairs (Defra)*. This has demonstrated the ability of the Newton Gateway to Mathematics to work closely and in partnership with funders and Government, to effectively respond to specific needs, deliver mathematical sciences knowledge exchange and create impact.

In 2019, the Gateway began a programme of work with *Dstl* and *PA Consulting*, with an aim to apply new or alternative mathematical approaches to challenges in the electromagnetic (EM) environment. An initial research scoping workshop took place in January 2020 that explored potential solutions to a number of identified challenges and work continues as part of the ongoing delivery of workshops and project activity.

As part of all these collaborations, the Newton Gateway to Mathematics develops programmes of work, disseminates information and develops strategic relationships, to ensure effective translation of science to the user. This has helped partners to understand and gain consensus on the challenges that need to be overcome and facilitate other interdisciplinary collaborations to enrich the existing communities.

Foreword

The year 2020 has been challenging for everyone and this Annual Report highlights "business as usual" for Newton Gateway to Mathematics activity until March 2020 and then provides details of all the collaborative virtual activity that the Gateway has helped to develop as a result of the COVID-19 pandemic. The Isaac Newton Institute temporarily closed on 20th March 2020, and for the rest of the reporting year, the Gateway staff worked virtually – ensuring regular contact with colleagues, partners and stakeholders.

It quickly became apparent that physical events would not be able to be delivered in the short term, so those that were planned from March onwards were rescheduled to take place later in the year. Plans for their delivery continued – making use of a wide variety of virtual technologies and networking activities that aim to replicate, as much as possible, the experience of attending a physical event.

In March 2020, in response to the COVID-19 pandemic, the *Virtual Forum for Knowledge Exchange in the Mathematical Sciences (V-KEMS)* was established. More information about the activities that have been developed and delivered can be read later in this Annual Report, but the main aim has been to identify a range of virtual approaches to help address challenges from business and industry, the third sector, and other groups outside academia. These challenges may have been long-standing or may have arisen directly as a consequence of the present disruption to UK society. *V-KEMS* delivery has been a truly collaborative programme and one that the Gateway and partners will use as a basis for the development of new and continuing activities over the coming year.

Earlier in the year, the Gateway and its partners started to explore the feasibility of a *National Connected Centres Knowledge Exchange Network*. *The Era of Mathematics* (known as the *Bond Review*) published in 2018, set out the narrative and vision for how the mathematical sciences knowledge exchange infrastructure could be transformed. In particular, it stated: *"A national centre in impactful mathematics for the UK should be created to work with industry and government. … This could be based on existing models … to act as a national KE hub."*

The proposal was that a scalable and flexible *Connected Centres Model* for fostering knowledge exchange could be established, with the Gateway and the *International Centre for Mathematical Sciences (ICMS)* serving as its hub, and made available to and for every mathematical sciences department in the UK. Because of COVID-19, discussion was paused in the first half of the year, but initial thoughts are that the Gateway and ICMS would organise the setting up of six regional centres or nodes, based in universities with an established track record for mathematics knowledge exchange. Assistance and support would then be provided via the nodes to satellites, which are the local partner university mathematics departments, and national and regional schedules of activities established.

Planning for the development of the *Connected Centres* will continue, and it is important to note that a shared technology platform will be critical, both for running events (which may be semi- or fully virtual) and ongoing operation between the Centres. The experience learnt from development and delivery of V-KEMS activities will prove invaluable.

Over the year, a number of Programmes of Work were delivered, including collaborations with the *EPSRC Centre for Mathematical Imaging in Healthcare (CMIH)*, the *Cantab Capital Institute for the Mathematics of Information (CCIMI)*, the *Knowledge Transfer Network (KTN)*, the *Natural Environment Research Council (NERC)*, *GCHQ*, the *Digital Catapult*, the *Engineering and Physical Sciences Research Council (EPSRC)*, the *International Centre for Mathematical Sciences (ICMS)*, *Dstl* and *PA Consulting*.

Despite the COVID-19 pandemic preventing staff from working in the building, INI and the Newton Gateway were very proud to be awarded a Gold *Green Impact Award* as part of the University's *Green Impact Accreditation* scheme. This encourages departments and colleges to reduce their environmental impact through a set of clear and achievable criteria related to water, waste, travel, energy, food, and other areas.

A large number of actions aimed at engaging staff and visitors and encouraging simple behavioural changes have been implemented. The auditors gave very positive feedback as well as helpful comments about activities to look at next year, for example *"We are extremely impressed by how much INI has managed to achieve this year - they have established sustainable action as integral to the way they operate"*.

Planning in support of post COVID-19 activity continues. Through its role on *V-KEMS*, the Newton Gateway was able to help make valuable links between those advising UK Government on *SAGE (Scientific Advisory Group for Emergencies)*, the *Royal Society's RAMP* Initiative *(Rapid Assistance in Modelling the Pandemic)* and a wide range of academic modellers. Discussions were also facilitated between participants of the INI *Infectious Dynamics of Pandemics Research* Programme and *V-KEMS* and activities and deliverables will continue in the coming year and beyond.

Through its engagement activity, the Newton Gateway to Mathematics has continued to extend its reach across different sectors. Delegates who attend Gateway events are offered greater opportunities for interaction between those in industry, the public sector and academia, often for individuals who have not worked together previously. As in previous years, activities have been delivered in partnership with other organisations, as detailed within this Annual Report, which has ensured further collaborative opportunities with new connections made across a breadth of sectors and subjects.

There have been many challenges faced by us all over the past year and the Newton Gateway to Mathematics is very grateful for the support given by *INI*, the *University of Cambridge* and our colleagues, partners and stakeholders. We recognise we have been in the fortunate position to be able to work effectively in novel virtual ways, and hence have ensured continued delivery of partnership activity. After some initial trepidation, the opportunities that delivering virtual events has brought have been explored widely and we look forward to continued development in the coming year, with the flexibility that virtual and semi virtual activity provide.

Staff and Management

Responsibility for the budget and financial planning is overseen by INI's Management Committee and undertaken on a day-by-day basis by Newton Gateway staff. The Gateway reports to the INI Director who in turn is responsible to the Management Committee.

The Newton Gateway is supported in delivering activity by the Gateway Advisory Board and Scientific Advisory Panel, who advise on programmes and activities and help with quality assurance in aspects of delivery and operations. The key aim is to help ensure that the highest levels of delivery and operations are achieved throughout Gateway activity and its effectiveness is fully maximised.

Newton Gateway to Mathematics Staff

The **Gateway Manager**, Jane Leeks, has overall responsibility for managing the Gateway and for developing contacts with mathematical and non-mathematical academics, with industry, business and public sector. This role is pivotal in identifying potential research opportunities of mutual benefit to mathematicians and industry.

The **Knowledge Exchange Coordinator**, Clare Merritt, supports diversification of Newton Gateway to Mathematics activities, coordinates and develops events and marketing activity with industry and businesses, and leads some specific programmes of work, including user engagement on behalf of Newton Gateway to Mathematics Partners. Clare leads on Gateway Governance.

The **Development & Communications Coordinator**, Ciara Dangerfield, supports the development of Gateway events and the building of links between academic and non-academic partners and helps with some technical aspects of event coordination and communication.

The **Events and Marketing Coordinator**, Lissie Hope, provides administrative support to Gateway events and marketing activities, as well as inputting to financial administration.

Governance

The* Newton Gateway to Mathematics *Advisory Board has Members from industry and public bodies to help advise on strategic matters and on the overall development of the Newton Gateway to Mathematics.

Members have helped to facilitate the delivery of a number of activities and programmes of work and act as "Ambassadors" for the Gateway in discussion and interaction with other partners.

The Board meets twice a year in Cambridge. The Chair is invited to attend *INI Management Committee* meetings to provide supplementary reporting on Gateway activity and delivery.

Membership (at July 2020):

Name	Organisation
David Abrahams	Isaac Newton Institute - Director
Matt Butchers	Knowledge Transfer Network
Alan Champneys	Representative of Gateway Scientific Advisory Panel
Nick Easton	BAE Systems Applied Intelligence
Joanna Jordan	Freelance Mathematics Knowledge Exchange
Peter Landrock *(Chair)*	Cryptomathic
Jane Leeks	Newton Gateway to Mathematics - Manager
Robert Leese	Smith Institute
Clare Merritt	Newton Gateway to Mathematics - Secretary
Dan Shepherd	National Cyber Security Centre
Sian Thomas	Department for International Trade
Stacie Tibos	PepsiCo International

The **Newton Gateway to Mathematics *Scientific Advisory Panel*** provides input and guidance on specific scientific or research matters related to Newton Gateway to Mathematics activities. Members are all academics and operate largely in a virtual capacity via email and telephone and are responsive to ad-hoc questions and requests for guidance from the Newton Gateway to Mathematics.

The Chair is invited to attend Newton Gateway to Mathematics Advisory Board meetings.

All Members of the *Scientific Advisory Panel* are invited to meet with the Advisory Board every 12 months to ensure they have opportunity to input more strategically to the range and nature of Newton Gateway to Mathematics activities.

Membership is regularly reviewed to ensure it reflects the breadth of disciplines that the Gateway can work on and a fuller geographical spread of representation by Members

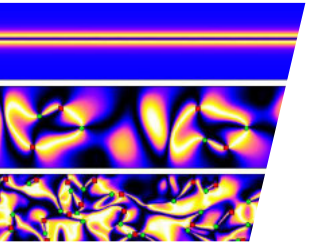
Membership (at July 2020):

Name	Organisation
Philip Aston	University of Surrey
Martine Barons	University of Warwick
Chris Breward	University of Oxford
Peter Challenor	University of Exeter
Alan Champneys (Chair)	University of Bristol
Chris Dent	University of Edinburgh
Rosemary Dyson	University of Birmingham
Jacek Gondzio	University of Edinburgh
Des Higham	University of Edinburgh
Jane Hutton	University of Warwick
Arieh Iserles	University of Cambridge
Gabriel Lord	Radboud University (and Heriot-Watt University)
Anotida Madzvamuse	University of Sussex
Adele Marshall	Queen's University Belfast
Jeremy Oakley	University of Sheffield
Surajit Ray	University of Glasgow
Nigel Smart	KU Leuven
Manuchehr Soleimani	University of Bath
Emily Walsh	University of the West of England
Adrian Weller	University of Cambridge
Helen Wilson	University College London

Activities from August 2019 - July 2020

4 – 6 September 2019

4th Edwards Symposium - Emerging Trends in Soft Matter



The *Edwards Symposium Series*, generously supported by Unilever, recognises the fast evolving and diverse nature of soft matter science and each year focuses on different areas of new and emerging science. In 2019, the workshop focused on new perspectives on detergency, active and driven phase separation, rheology of dense suspensions and environmentally sustainable plastics. These themes pose fundamental questions in basic science that were addressed by academic speakers and their relevance was discussed by industrial participants.

James Hallett from the *University of Oxford* was awarded the Alexei Likhtman Poster Prize. John Kolinski *(École Polytechnique Fédérale de Lausanne)*, Ren Liu *(University of Cambridge)* and Chris Ness *(University of Cambridge)* won the *Royal Society of Chemistry* poster prizes.

23 – 24 October 2019

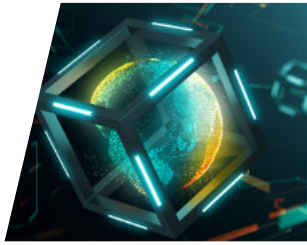
Artificial Intelligence Developments in Healthcare Imaging

This EPSRC *Centre for Mathematical Imaging in Healthcare (CMIH)* engagement event focused on artificial intelligence and featured presentations from *CMIH* researchers and Industry Partners, other academics and end users in the public sector and industry. The talks highlighted a number of different aspects related to medical imaging and provided the opportunity for knowledge exchange and networking between senior scientists from areas such as mathematics, statistics, engineering, physics and biomedicine and relevant individuals from industry and government.

A number of industry challenges and collaborations were presented in the elevator pitch session. A variety of posters were presented and a prize was awarded to Richard Shaw from *University College London* for the most enlightening poster from an early career researcher.

6 November 2019

The Future of Distributed Ledger Technology

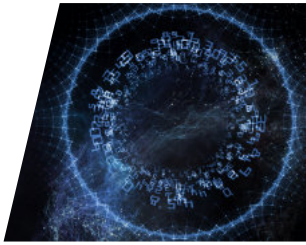


Distributed Ledger Technology (DLT) and its numerous potential applications, has gained increasing attention in recent years. The UK showed early interest in the technology and through strong research effort is now recognised as a global player. This workshop was a collaboration with *GCHQ*, the *Digital Catapult* and the *Engineering and Physical Sciences Research Council (EPSRC)* and aimed to support appropriate use cases and promote research into scalable DLT.

The event provided an overview of the current situation and talks explored research areas and applications that identified challenges and future opportunities. It finished with a shared discussion from key stakeholders that highlighted mechanisms and initiatives to bring about a greater funding commitment and structured research agenda for DLT in the future.

27 November 2019

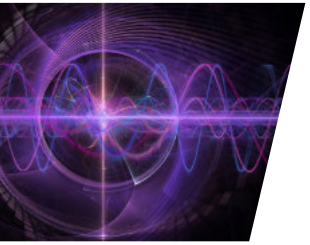
Cantab Capital Institute for the Mathematics of Information - Connecting with Industry



The *Cantab Capital Institute for the Mathematics of Information (CCIMI)* annual Industry engagement day showcased the research carried out at the Institute and enabled delegates to hear more detail about project collaborations and industry challenges.

The talks explored the big questions in data science, especially where mathematics is most suited to help provide answers. Presentations were given by the *Alan Turing Institute, British Antarctic Survey/ World Wildlife Fund, Tenoke Ltd, Mathworks* and *Google Deepmind*. As in previous years, a session of shorter talks was given by CCIMI researchers, providing more detail on some specific projects that they were involved in. Posters were encouraged and a prize was awarded to Kirill Kalinin from *University of Cambridge* for the most illuminating poster from an early career researcher.

8 - 10 January 2020



Mathematical Challenges in the Electromagnetic Environment

The UK needs to be able to operate in the electromagnetic environment (EME) across all domains; space, air, land, sea and cyber. Operating in the EME is an increasingly complex task as it becomes more congested and contested due to continuing growth in civilian and military demand for spectrum (for example 5G). Current approaches to solving the challenges of operating in the EME have been successful over many years, but ever increasing complexity, new technology and the increasing scale of data, means it is now necessary to explore innovative approaches.

This three-day challenge workshop in partnership with *Dstl* and *PA Consulting* aimed to investigate mathematically led solutions to defined challenges in the EM environment. The event brought together relevant stakeholders from across various mathematical fields with electromagnetic environment domain experts to explore novel ways to address some specific challenges, with the expectation that innovative maths led approaches would arise. This is an ongoing Programme of Work - the output of which will be an assessment of a set of innovative mathematical approaches to the key challenge areas with the intention to exploit these in future projects and to help inform *Dstl* in their longer term strategic thinking.

Innovative Mathematics for the Modern Industrial Strategy

3 – 14 February 2020

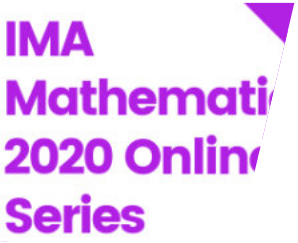
For many decades there has been a need for mathematical innovation in industry, especially in our largest R&D intensive companies. In 2019, a meeting at the *International Centre for Mathematical Sciences* scoped possible mathematical topics and identified some key areas that could both stimulate mathematical innovation and offer exciting possibilities of adding value to industry.

Two of the areas identified as offering the greatest chance of providing demonstrable value to industry were:

- Physical Modelling for Formulation - where mathematical innovation is expected in mathematical models for multi-faceted industrial processes, materials modelling, homogenisation, optimisation, inverse problems and numerical analysis.
- Network Theory and Optimal Control for the Circular Economy - mathematical innovation is expected at the intersection of network science, economics, dynamical systems, stochastic optimisation, and game theory as applied to a wide variety of business models.

These topics were delivered as two week-long workshops in partnership with the Isaac Newton Institute and the *Knowledge Transfer Network*. At each workshop, a number of next steps were discussed, including submitting bids for funding to work with partners on some specific challenges and on the solution strategies identified.

6 July 2020



IMA Mathematics 2020 Online Series

For a number of years, *The Institute of Mathematics and Its Applications (IMA)* has been running a series of conferences to promote mathematics, with the aim of demonstrating to both mathematicians and non-mathematicians the many uses of modern mathematics. *IMA Mathematics 2020* took place virtually in a series of weekly two hour events. Four events were scheduled and the Newton Gateway worked in partnership to include talks from some speakers involved in Gateway current and future activities.

Professor Jane Hutton *(University of Warwick)* gave a taster of *Mathematics and Statistics for Effective Regulation* due to take place in November 2020. Professor Nigel Smart *(KU Leuven)* spoke about *Privacy Enhancing Technologies*, in advance of a series of Gateway events being delivered in November and December 2020.

Professor Chris Budd *(University of Bath)* gave a presentation on *V-KEMS* – the rationale for its formation, working with the broader mathematical community and the variety of activity that it has been able to deliver over a relatively short period of time.

Knowledge Exchange Activities for INI Research Programmes

The Isaac Newton Institute sponsors Knowledge Exchange activity, referred to as 'Open for Business' (OfB) knowledge exchange events, as a part of its continuing objective of bringing academic researchers involved with its research programmes into contact with industrial, commercial and government organisations and individuals.

These activities, which are delivered by the Newton Gateway to Mathematics, provide opportunities for cross-fertilisation between the activities of users from industry and the public sector, and the research focus of the Institute. OfB events are structured to enable the formation of new public-private partnerships, collaborative research and to assist in identifying the common challenges that have greatest potential for research, knowledge exchange, public policy and commercial impact.

Three *OfB* events were hosted during the reporting year and these were developed and delivered with the academic organisers of the three INI Research Programmes that took place over this period. These were *Mathematical and Statistical Challenges to Landscape Decision Making*; *Complex Analysis: Techniques, Applications and Computations* and *Geometry, Compatibility and Structure Preservation in Computational Differential Equations.*

2 August 2019

Next Generation Research and Modelling for Landscape Decisions

This event was part of the Research Programme on *Mathematical and Statistical Challenges to Landscape Decision Making* and helped inform future funding programmes for landscape decisions. It aimed to encourage collaboration between a highly interdisciplinary mix of both academic and non-academic researchers and policy makers working on land-related research and policy questions, in order to harness the potential to significantly advance modelling of landscape systems.

The event took part at the end of the Research Programme so explored some key questions which had been considered, such as the minimal useful representation of the landscape system, how to robustly model the coupled human-environment system, identifying the non-linearities and sensitivities of the system and how to reconcile scale disconnects between different elements of human-environment systems.

30 October 2019

Industrial Applications of Complex Analysis

Complex analysis is a branch of mathematics that studies analytical properties of functions of complex variables. It lies on the intersection of several areas of mathematics, both pure and applied, and has important connections to asymptotic, harmonic and numerical analysis. Techniques based on complex variables are very powerful, with a large number of applications to the solution of physical problems.

This event was delivered within the *Complex Analysis: Techniques, Applications and Computations* Research Programme. It reflected the breadth of application areas where complex analysis methods are important and included talks representing both academic research and end-user perspectives from a range of different industrial areas. Talks also highlighted how complex analysis methods have the potential to tackle challenging problems in a number of areas including understanding of aeroacoustics, medical imaging methods, tissue engineering approaches and radar signal processing.

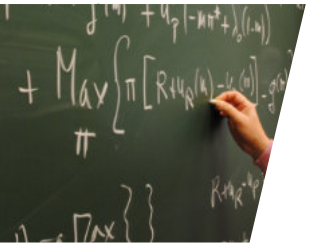
Advances in Numerical Modelling

3 December 2019

Geometric and structure preserving methods are a special class of numerical algorithms used to compute solutions to differential equations that preserve the underlying geometry and structure of the system. The key advantage of these methods is that they are not only computationally fast, but they also improve the accuracy of the computation since they are both quantitatively and qualitatively precise.

This workshop took place in the *Geometry, Compatibility and Structure Preservation in Computational Differential Equations* Research Programme. It showcased recent applications of geometric and structure preserving methods to models of real-world systems, as well as highlighting where advances in these types of numerical methods are most needed. It helped to illustrate the wide range of application areas where geometric and structure preserving numerical methods are used and included academic talks and different perspectives from a number of application areas.

Virtual Forum for Knowledge Exchange in the Mathematical Sciences (V-KEMS)



In March 2020, in response to the COVID-19 pandemic, the *Virtual Forum for Knowledge Exchange in the Mathematical Sciences (V-KEMS)* was established. The Newton Gateway to Mathematics, Isaac Newton Institute (INI), *International Centre for Mathematical Sciences (ICMS)* and *Knowledge Transfer Network (KTN)* have been working with various representatives from the mathematical sciences community to develop this virtual forum. The main aim has been to identify a range of virtual approaches to help address challenges from business and industry, the third sector, and other groups outside academia. These challenges may have been long-standing or may have arisen directly as a consequence of the present disruption to UK society.

Many initiatives were already taking place to help provide infrastructure and resources to clinicians and others who were urgently helping to model the current pandemic. Where appropriate, *V-KEMS* has provided direct support to this activity. However, *V-KEMS*' main focus has been to identify broader areas for input from the mathematical sciences community – for example tackling issues related to food supply and logistics etc.

Activities

A number of activities have been taking place:

- Mathematical Support to Business, Industry, the Public and Third Sectors
- Webinars/Scoping Meetings
- Virtual Study Groups.

Mathematical Support to Business, Industry, the Public and Third Sectors

Where industry, business, the public sector or the third sector have an identified problem that would benefit from mathematical input (such as physical modelling, statistics, data analysis etc.), *V-KEMS* has been able to help facilitate this, by putting the organisation in contact with relevant individuals or teams from the mathematical sciences community who will undertake a scoping and triaging process.

Webinars/Scoping Meetings

V-KEMS has also been able to provide the infrastructure to host appropriate webinars and scoping meetings online. These have included talks, with options to participate in parallel sessions via virtual breakout rooms.

Virtual Study Groups

Much of *V-KEMS* activity has focused on the development and delivery of Virtual Study Groups – a number of which have input directly to advice being developed by officials who have been working with Government in response to COVID-19.

The Newton Gateway has been directly involved in the development and delivery of several of the Virtual Study Groups, including *Guiding Principles for Unlocking the Workforce - What Can Mathematics Tell Us* in May 2020 and *Unlocking Higher Education Spaces* that took place in June 2020.

Unlocking Higher Education Spaces

This study group focused on applying mathematical tools and models to various issues linked to the complex challenges associated with the safe return of students and staff to Universities. Around 40 researchers and end-users were assembled to discuss and provide potential avenues of exploration for opening up universities. A working paper was subsequently published which highlighted the discussions that took place, the initial findings and several modelled solutions for the safe return of staff and students to the University environment.

Feedback from this Study Group was discussed and then explored with participants of the INI *Infectious Dynamics of Pandemics* Research Programme. Dialogue also took place with the *Department for Education*, the *Department of Health and Social Care*, *Universities UK* and the *Scottish Government* and the *Welsh Government*.

Virtual Forum for Knowledge Exchange in the Mathematical Sciences (V-KEMS)

162nd European Study Group with Industry

ESGI 162 took place virtually in July 2020 and was hosted by the *University of Leeds* and delivered by *ICMS* with support from the *Newton Gateway* and the *KTN* as part of *V-KEMS*. It attracted over 100 participants from academic institutions across the UK, as well as some who were able to join from elsewhere in the World, due to its online delivery.

Eight problems from industry were presented by seven different companies - *Dstl, Faraday Predictive Ltd, Innovation Embassy, Mercer, Transfinite, Vet AI* and *Zenotech*. Work-groups were then formed with the aim of producing viable solutions that were presented back to the problem presenters at the end of the week.

Feedback from the organisations which set the challenges was encouraging, including "a really solid foundation has been started", "really interesting analysis that we can do a lot with", "impressive & amazing outputs", and "delighted to get 2 different angles and hope we can use these in a relatively short timescale". This was particularly encouraging as a number of the groups were working across several different time zones!

More information on *V-KEMS* activity can be found on the website www.vkemsuk.org and through its Twitter account www.twitter.com/V_KEMS

Participation

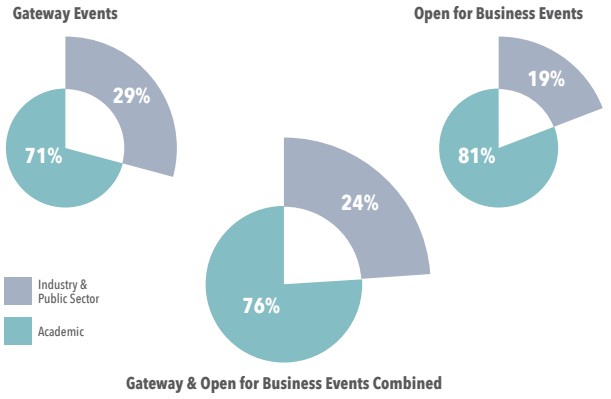
The Newton Gateway to Mathematics remains successful in facilitating links between industry, academia and the public sector, ensuring participation from a significant number of researchers in disciplines other than the mathematical sciences.

Due to COVID-19, a number of events that were in development were rescheduled for delivery in 2020-2021, when they will take place virtually or semi virtually. From March 2020, the Gateway has been key to development of *V-KEMS* activity in the form of web meetings, webinars and virtual study groups. These events were developed and delivered in partnership with the I*nternational Centre for Mathematical Sciences (ICMS), Knowledge Transfer Network (KTN)* and Isaac Newton Institute (INI). More than 120 different organisations and over 700 delegates have been involved to July 2020, but these numbers are not captured in the participation rates below as they were fully collaborative activities with the four partners.

The Gateway continued to engage across a wide range of sectors, with 615 delegates attending the nine events that it developed and delivered between August 2019 and July 2020. The number of delegates is reduced compared to previous years because of the rescheduling of events due to COVID-19. The diversity of sectors has expanded and includes analytics, biotechnology, communication, data science, defence, energy, engineering, environment, finance, healthcare, information technology, medical imaging, security, space, technology and transport. Engagement with *V-KEMS* partners has helped to expand some specific academic sector contacts as well as those involved in health, social care and education.

As in previous years, Open for Business events took place related to the Research Programmes held at INI and these attracted a higher proportion of academics than industry or public sector attendees. However, each of the Gateway events were attended by delegates from a wide range of academic disciplines, so enabling discussion linked to other relevant fields of research.

These charts show attendance at Gateway delivered events, divided by affiliation.



Accounts to 31 July 2020

	Actual 2019 - 2020 £000's	Actual 2018 - 2019 £000's
Income		
University of Cambridge Funding [1]	55	55
'Open for Business' Events Income [2]	7	17
Gateway Events Income [3]	99	143
Isaac Newton Institute [4]	141	119
Total Income	**302**	**334**
Expenditure		
Staff Costs	196	174
'Open for Business' Events Expenditure	7	27
Gateway Events Expenditure	84	80
Overheads & Administration	8	16
Total Expenditure	**295**	**297**
TOTAL SURPLUS/(DEFICIT)	**7**	**37**

[1] University of Cambridge Higher Education Innovation Funding

[2] OFB Income - EPSRC	7,176
OFB Income - registration fees	175
	7,351
[3] Event Income - sponsorship	87,256
Event Income - registration fees	11,774
	99,030

[4] INI contribution to staff costs

Grants and Funding

The Newton Gateway to Mathematics is an integral component of the *Isaac Newton Institute* and therefore support is provided by *INI* to enable the Gateway to continue to develop and expand its current service to the community.

The *University of Cambridge* has contributed to the funding of the Newton Gateway to Mathematics through the *Higher Education Innovation Funding* scheme, which has partially covered administrative costs but not expenses for specific Gateway activities. The latter are funded through partnerships with stakeholders including from industry and the public sector, philanthropy and participant registration fees.

Future Development

The Newton Gateway to Mathematics aims to respond in a speedy and focused way to new ideas and approaches, but recognises the need for a targeted and continuous approach to the delivery of longer term knowledge exchange activities in the mathematical sciences. The series of Thematic Knowledge Exchange Programmes are designed to stimulate and support research activities and include workshops, consultations and project meetings. These include Mathematics of Big Data, Mathematics for Biology and Healthcare Systems, Mathematics for the Environment and Energy, Mathematics for Financial Services, and Mathematics for the Space and Security Sectors.

Activity from September - December 2020

With its aspiration of playing a key national role in mathematical sciences knowledge exchange, the Newton Gateway to Mathematics has developed the following activities in collaboration with stakeholders, funders and other academic partners.

Integrating Quantitative Social, Ecological and Mathematical Sciences into Landscape Decision-making (7-11 September 2020)

Mathematical Challenges in the Electromagnetic Environment (15 – 18 September 2020)

Mathematics and Statistics for Effective Regulation (17 November 2020)

Privacy Enhancing Technologies in Practice - Series of Short Workshops (19 November, 30 November, 8 December & 15 December 2020)

Mathematical Foundations of Optimisation in Data Science (24 November 2020)

Cantab Capital Institute for the Mathematics of Information - Connecting with Industry (25 November 2020)

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