



**Smith** *institute*  
for industrial mathematics and system engineering

# Insight

Harnessing mathematics to boost innovation

## Building trusted relationships

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## Applying mathematical approaches to complex problems

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## Enabling informed decisions



## Introduction

Successful innovation relies on creative thinking coupled to the infrastructure and mechanisms that translate this thinking into commercial reality. Nowhere are the possibilities more exciting than in the harnessing of mathematics, and this is the space in which the Smith Institute operates.

The opportunities are all around us. Quantifying and managing uncertainty; complex operational planning; real-time decision-making; building new services and processes: these challenges are multi-sectoral and their solutions are greatly enhanced by establishing a firm underpinning through mathematical thinking - what we often call 'modelling'.

For many of our clients, we find that there are proven approaches in very different areas of application, which are cost-effective to adapt for new purposes. This is why the Smith Institute is able to operate effectively across multiple business sectors. We are ideally placed to identify and leverage connections on a broad front, to make progress quickly and with confidence. By working with the Smith Institute, businesses create value from relevant mathematical ideas that would otherwise be missed.

The following pair of examples gives a flavour of our work (further information on these and other projects appears later in this brochure). We are embarking on a long-term programme to support Radioactive Waste Management Ltd in the modelling that will underpin the UK's nuclear waste storage strategy. This challenge is highly multidisciplinary and we will be engaging with our network of academic colleagues. In a completely different arena, we have recently completed work with the Federal Communications Commission in Washington DC, to verify an auction programme with the dual objectives of releasing radio spectrum for expanded mobile data services and improving the efficiency of broadcast services. This was one of the largest auctions ever held, in any sector, and certainly the most complex, with a value measured in tens of billions of dollars.

*Looking forward, we are building relationships with key clients to align the development of our own staff capabilities with their anticipated challenges to accelerate innovation when and where it is needed.*

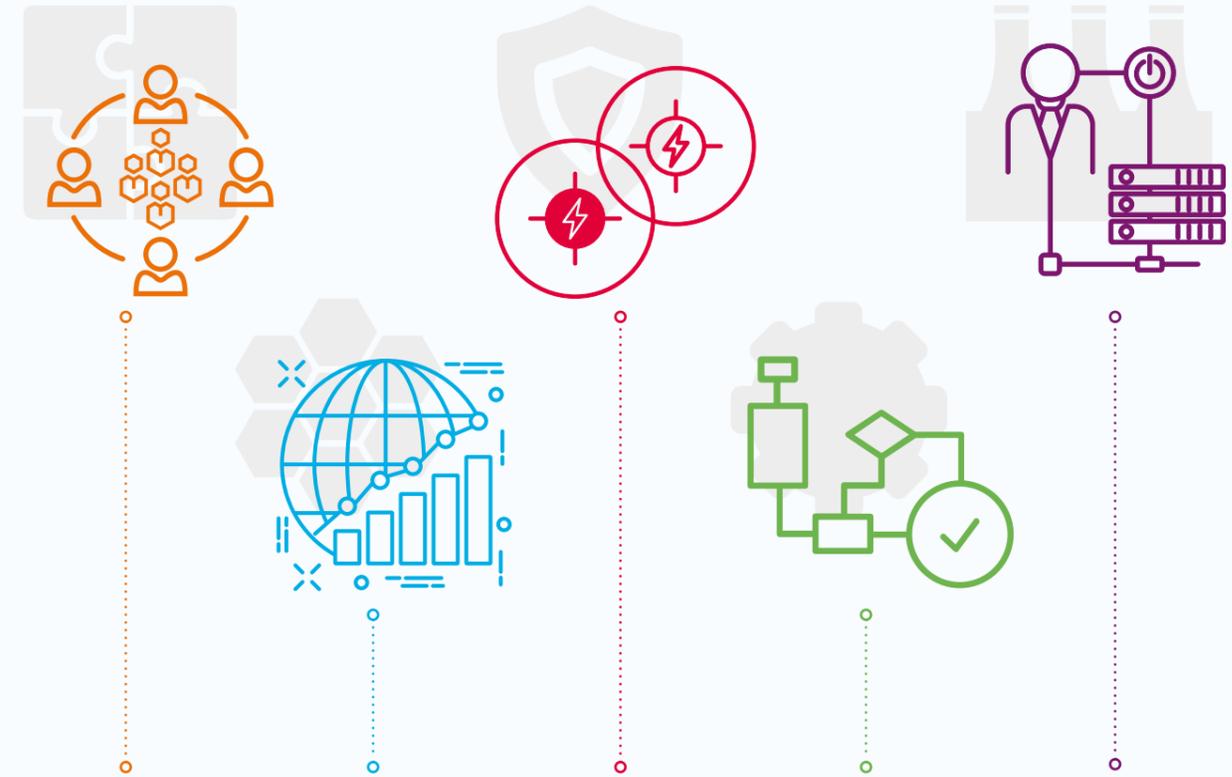
A handwritten signature in black ink, reading "Heather Tewkesbury". The signature is fluid and cursive, with a large, stylized initial 'H'.

Dr Heather Tewkesbury  
Chief Executive Officer, Smith Institute

# What we do

*The Smith Institute specialises in solving complex problems for businesses and governments by applying mathematical thinking and techniques. We build trusted relationships with our clients and collaborators, offering expert insight to support informed decision-making and reduce risk.*

**Smith institute**  
*for industrial mathematics and system engineering*



We work with organisations to develop an in-depth understanding of their domain areas, the challenges they face and the services they want and need.

Our well-established business model is built around client projects. Each project provides solutions designed to meet individual client requirements. Successful outcomes rely on clearly understanding the requirements and the work that is needed to deliver against them.

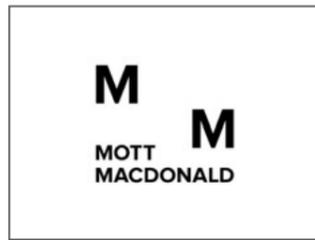
We help our clients assess feasibility, de-risk and make informed decisions by modelling 'as is' and multiple 'what if' scenarios. This help saves our clients' time and money, as well as substantially reducing their risk of reputational and/or financial damage.

We use system engineering, data analysis, algorithm development and model building techniques. Working in this way is vital for maximum understanding, including the capacity to stress-test and understand uncertainty.

Our unique position working with the academic community enables us to leverage the latest research to meet industrial and organisational need. This makes our solutions rigorous, robust, and bespoke to our clients' requirements. We are experts at translating research in the mathematical sciences and applying this to real-world problems in a timely and usable way.



# Our Clients



Working in partnership with Mott MacDonald to improve data-driven services for infrastructure asset management



A model-based methodology for prioritising allocation of decontamination resources



Assuring optimal schedules for National Grid's Electricity Balancing System



Working with G's Growers to optimise lettuce production



Creating innovative optimisation tools for spectrum management



Auditing and improving algorithms for route and territory optimisation



Working with Air Traffic Controllers to increase efficiency of UK airspace



Providing facilitation and knowledge exchange expertise for the multidisciplinary research programme on Probability, Uncertainty and Risk in the Environment

# Our Achievements



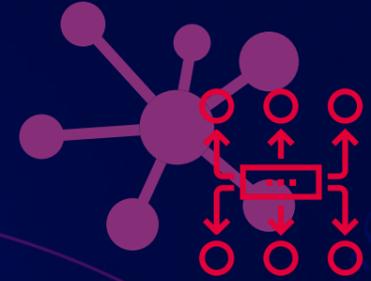
We work across **10** SECTORS



helped in the last 2 years



**15** AUCTIONS supported across  
**10** COUNTRIES creating access to new spectrum worth over **£25bn**



**85** MODELS/ALGORITHMS designed



**266** COLLABORATIONS stimulated  
 68 PhD Studentships  
 115 Study Group Problems  
 10 Postdoctoral Research Associates  
 73 Internships



**74** TECHNICAL WORKSHOPS facilitated



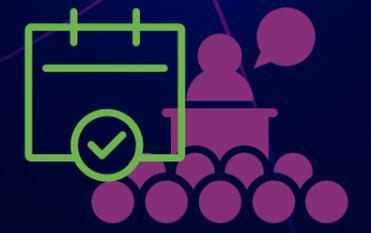
We have elicited **342** student applications for TakeAIM



We have contributed to **>55** CONSULTATIONS & REVIEWS



**GLOBAL REACH**  
 Working with customers in **7** different countries



**>50** Invited LECTURES given

# Forward Plan

On 15th May 2017, Dr Heather Tewkesbury was appointed as Chief Executive Officer of the Smith Institute and Dr Robert Leese took on the new role of Chief Technical Officer.

This change was designed to support the Institute through its next phase of growth, with the creation of new capabilities for clients built on firm foundations of scientific excellence. It provides fresh opportunities for staff and collaborators, as we continue in our mission to enable business and government to innovate with the insights we provide using mathematics.

The Institute's future will continue to be built around trusted relationships with the scientific community. These relationships enable us to anticipate and understand future requirements and techniques to assemble the teams that are best placed to deliver them. We will continue to build capability by recruiting and developing talented mathematical scientists who are motivated by the unique work that we do.

Our mission is to empower clients, staff and collaborators to realise new opportunities through the application of mathematical thinking.

*Which opportunities can we help you to realise?*



# The Team

David Miller

Georgina Lang

Nigel Marsh



Andrei Bejan



Alexi Reynolds



Tim Boxer



Anna Railton

Heather Tewkesbury



Caroline Edwards



Zoe Kelson

David Wyncoll



Robert Leese



Thomas Hawes



Vera Hazelwood



Melvin Brown



Michelle Ledbetter



Claudia Centazzo

Rachael Warrington

Holly Gurr

Jakob Blaavand

David Allwright



Judy Reynolds



Gillian Hoyle

Michael Hobson



## Strategic Areas

As part of our strategy for growth, we are building portfolios of projects that draw upon common bodies of prior experience. We currently have four main areas of strategic focus, however we are continually evaluating the landscape to identify gaps and new opportunities for development.

### Decision Making under Uncertainty

*We specialise in modelling and analysing scenarios to support and inform decision making under uncertainty. We apply operational research and statistical techniques, such as optimisation and probabilistic modelling, in response to our clients' business-critical needs and requirements.*



## Optimising Lettuce Production

G's Growers Ltd is an independent agricultural producer that comprises more than 20 grower members in the UK and Spain. Their crop range includes leaf salads and many other vegetables. G's Growers members farm collectively over 7,500 hectares of specialist crop which they harvest, process or pack for sale onto their end customers and consumers across the UK, continental Europe and North America.

With the advent of satellite image and weather observations, GPS and high-precision sensor based technologies and the emergence of field specific crop management concepts - collectively known as precision agriculture - the complexity of underlying systems, processes and logistics has greatly increased.

The Smith Institute is using its expertise in decision making under uncertainty to help G's Growers make best use of increasing volumes of collected data and formulate better decisions in order to optimise production and minimise waste.

Take iceberg lettuce – this is one of the largest crops by volume, with around three million heads sold per week. It is also the most volatile crop in terms of matching availability and demand, hence the importance of maintaining control over the

full vertical integration of plant raising, farming, harvesting, packaging, marketing and selling.

In our work we use an advanced statistical growth (or lettuce readiness) model that turns historical observations and the current weather forecasts into predictions regarding crop readiness. The model also shows how the available control choices affect the probability of undersupplying and the probability distribution of waste. Optimal plans for sowing, planting and harvesting are devised using the methodology of large scale linear programming. Furthermore, the output contributes to building systematic methods that partner growers could use to predict the effect on availability of crop, from sowing to harvesting, in different scenarios before and during the season. This means they can adjust and re-evaluate planting schedules on the fly throughout the year.

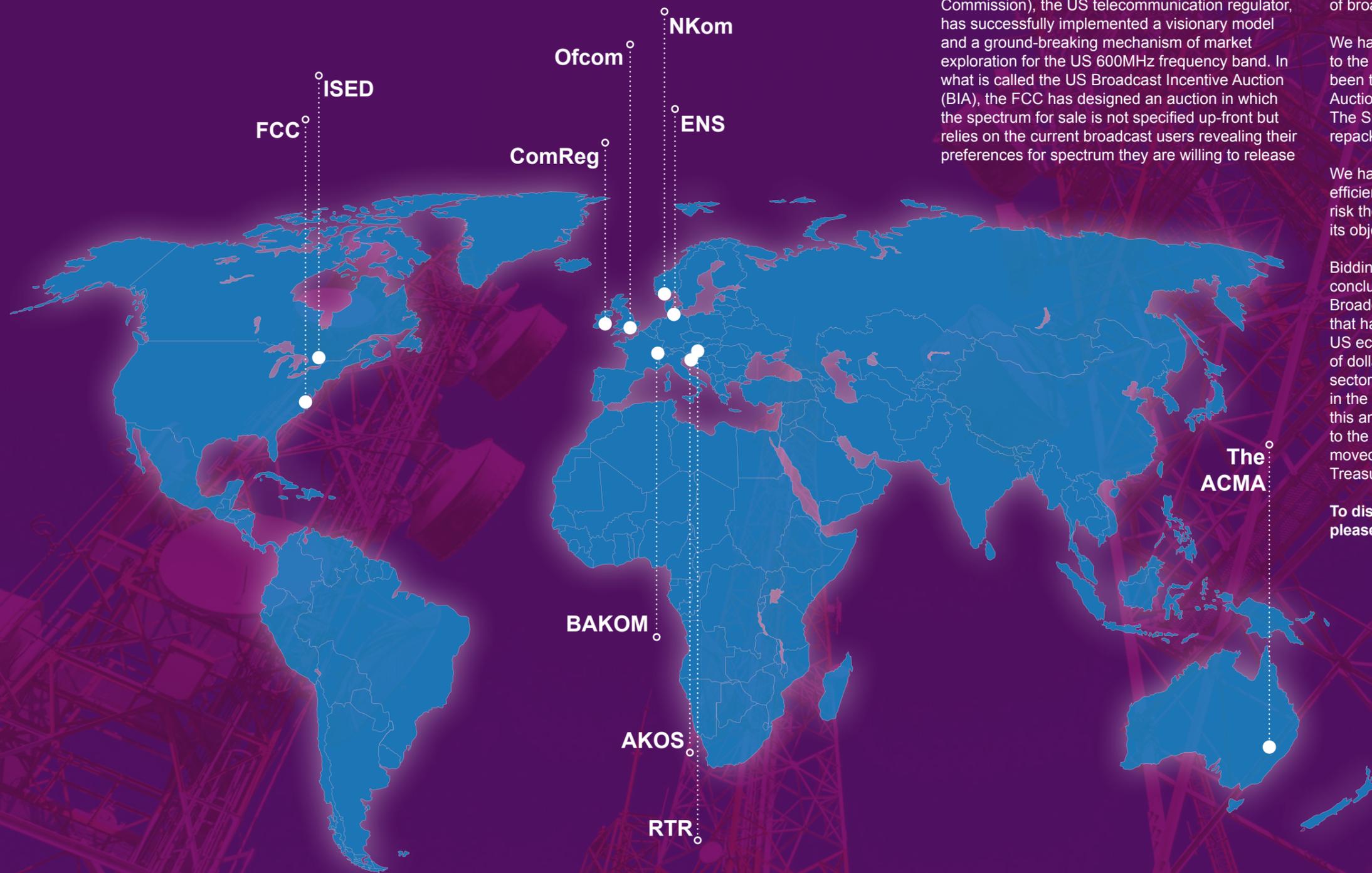
Ultimately, it is expected that the improved growth model and the optimiser will help to quantify the risks associated with different scenarios and hence optimise planting and supply programmes as well as minimise overproduction volumes.

**To discuss the ways we can help you to make informed decisions, please contact**  
[zoe.kelson@smithinst.co.uk](mailto:zoe.kelson@smithinst.co.uk) or  
[michael.hobson@smithinst.co.uk](mailto:michael.hobson@smithinst.co.uk)



## Spectrum Optimisation

*We provide rigorous independent verification and quality assurance for radio spectrum auctions. Working with regulators and leading telecoms organisations worldwide, we have world-renowned experience in de-risking the auction process by applying our robust mathematical thinking. Our innovative spectrum optimisation techniques support mobile operators and policy makers to utilise spectrum more efficiently in our highly-connected world.*



## From TV channels to mobile wireless

Radio spectrum auctions are a well-established mechanism of awarding spectrum to the ones who are willing to pay the most for it. Spectrum auctions are not new to the Smith Institute: we have been working on algorithmic verification of combinatorial clock auctions since Ofcom introduced this design to the European telecommunications industry in 2006.

More recently, the FCC (Federal Communications Commission), the US telecommunication regulator, has successfully implemented a visionary model and a ground-breaking mechanism of market exploration for the US 600MHz frequency band. In what is called the US Broadcast Incentive Auction (BIA), the FCC has designed an auction in which the spectrum for sale is not specified up-front but relies on the current broadcast users revealing their preferences for spectrum they are willing to release

in return for different levels of payment. Then, this “relinquished” spectrum is put forward to be auctioned and assigned to the companies making the best offers for new uses of the frequencies. The value created is greatly boosted by “repacking” the spectrum that is retained for broadcast use. This repacking maximises the amount and the quality of spectrum that can be released, while protecting the coverage and service quality enjoyed by consumers of broadcast services.

We have provided extensive verification services to the FCC in the delivery of the BIA. Our role has been to verify all the algorithmic components in the Auction System, and the interactions between them. The Smith Institute was key in the verification of the repacking software.

We have contributed to the overall reliability and efficiency of the Auction System. We helped to de-risk the BIA auction process and ensure that it met its objectives to create economic value.

Bidding in the BIA started in March 2016 and concluded one year later, in March 2017. The Broadcast Incentive Auction is unlike any auction that has previously been attempted. Its value to the US economy will be measured in tens of billions of dollars. The value to the telecommunications sector itself is indicated by the total of winning bids in the Forward Auction, amounting to \$19.6bn. Of this amount, more than \$10bn is being provided to the broadcasters who relinquished spectrum or moved bands and more than \$7bn directly to the US Treasury for deficit reduction.

**To discuss how we can verify your systems please contact [claudia.centazzo@smithinst.co.uk](mailto:claudia.centazzo@smithinst.co.uk)**

## Security

*We specialise in analysing data, developing models and implementing algorithms to address threats to public safety and security.*

## Efficiency, capacity and safety in Air Traffic Operations

NATS is the UK's leading provider of air traffic control services. Each year they handle 2.4 million flights and 250 million passengers in UK airspace. As the demand for air travel increases, NATS needs to identify ways to increase efficiency and capacity of the airspace they control, while maintaining safe operations. This motivates the challenge to support the roles and responsibilities of air traffic controllers with technologies that provide automated capability in handling uncertainty and complexity in Air Traffic Management.

During early 2017 the Smith Institute worked with Air Traffic Controllers and research staff to help NATS address this challenge by convening a workshop of academic experts from relevant fields of the mathematical sciences. We helped NATS to map existing and developing research themes onto different approaches to airspace management and traffic synchronisation. NATS is now prioritising those research themes to form a programme of Research & Development to secure their competitive edge into the future.

**To discuss how we can help you to understand your systems please contact**  
[heather.tewkesbury@smithinst.co.uk](mailto:heather.tewkesbury@smithinst.co.uk)  
or [georgina.lang@smithinst.co.uk](mailto:georgina.lang@smithinst.co.uk)

*“The workshop was an excellent opportunity for NATS Air Traffic Controllers and scientists to engage directly with university academics to understand how modern mathematical science can help address the challenges that we are presented with in designing our future airspace.”*

*By creating a shared understanding of our business needs and applicable ‘state of the art’ scientific research, this collaboration has helped us to identify the right fields of research for future investment, and potential partners with whom to collaborate.”*

**Mark Watson, Head of R&D at NATS**

## Knowledge Exchange

*We have an extensive academic network and experience in research management, facilitation, design of research programmes and coordination. This enables us to assemble groups of experts quickly, establish collaborative projects, and access cutting-edge science to solve business and policy problems. Furthermore, our knowledge exchange initiatives and partnerships create opportunities for academics and young researchers in particular, to bring their work to the wider attention of business.*

## Transforming the quantification of uncertainty and communication of risk for natural hazards

The number of major disasters resulting from natural hazards has risen dramatically since the 1970s, and is still increasing. From floods and ash clouds, to droughts and earthquakes, natural hazard events claim thousands of lives every year, and financial losses amount to billions of dollars. While events such as these are often confined to hazard prone areas of the world, the UK is not immune to the impacts of natural hazard events.

The Natural Environment Research Council (NERC) is the leading funder of independent research, training and innovation in environmental science in the UK. It invests public money into world-leading science, designed to help sustain and benefit from natural resources, predict and respond to natural hazards, and understand environmental change. Working closely with academics, policy makers, businesses and the third sector, NERC supports knowledge transfer for sustainable economic growth and wellbeing in the UK and around the world.

NERC's £7m Probability, Uncertainty & Risk in the Environment (PURE) Research Programme was established in 2012. It was designed to help the UK government and industries as diverse as finance, energy and aviation, to be better prepared for natural hazards. To achieve its aims, the programme was supported by the PURE Network, developed and managed by the Smith Institute.

Over the 5 years of the PURE Network, the Smith Institute organised 26 events, established 24 collaborative projects and created a network of over 1,000 people, including representatives from more than 100 companies and government departments.

**To discuss how we can facilitate exchange of knowledge to help your organisation please contact**  
[vera.hazelwood@smithinst.co.uk](mailto:vera.hazelwood@smithinst.co.uk)

*“PURE has provided a great opportunity to combine expertise in different aspects of environmental physics with expertise in statistics. From our point of view the combining of understanding of atmospheric physics, volcanology, satellite retrieval algorithms and statistical emulators has been particularly valuable in making progress on the problem of volcanic ash prediction.”*

**Met Office**

*“Having seen the immediate aftermath of devastating earthquakes, it is clear that we do not know enough about the pattern of aftershocks and the risks they pose to vulnerable communities. This [PURE Associate] project, for the first time, gives us a tool that will help us make decisions about how and where to programme our responses.”*

**Concern Worldwide**

# European Study Group with Industry (ESGI)

*By bringing together people from a wide range of backgrounds to focus on issues with real importance to industry, study groups help facilitate improvements for industry and excellent mathematical research.*

Since 2001, the Smith Institute has supported the annual UK ESGI in partnership with a host University, bringing mathematicians and industrialists together over an intensive week-long event to solve the real and critical issues that companies are facing.

Representatives from industry present problems to mathematicians on the first day of the workshops. Over the following days, the mathematicians and industrialists suggest and discuss ideas then work together to find practical solutions. On the final day, the mathematicians give presentations on the progress made, and in the following weeks they prepare reports for the companies, to describe in detail what was achieved and the opportunities for further work.

This simple format has proved its value again and again: companies from a wide range of industries have benefited from the insights gained through mathematical analysis of their problems, while mathematicians with diverse interests have benefited from the exciting research opportunities presented by unsolved problems with practical significance.

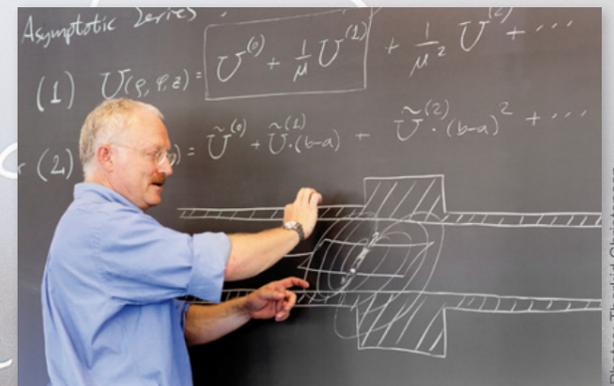
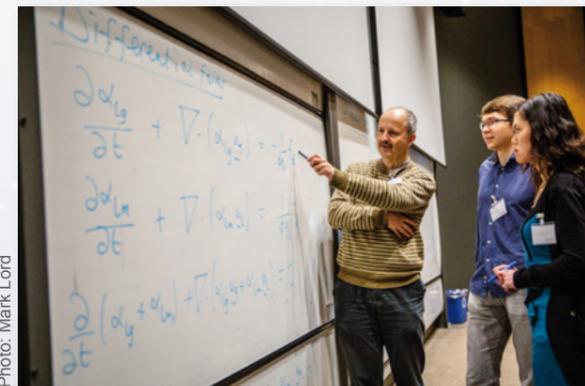
*We took a long-standing problem that had us mystified to the Durham Study Group. During a thoroughly enjoyable week we solved it! I presented the results at a conference a couple of months later and we have already applied the learning to set the direction of stewardship of our products in the field.*

**Paul Sweeney, Principal Scientist, Syngenta**

When asked in 2017 about the ongoing impact of participating in the 2012 UK Study Group:

*Our company continues to benefit from the sage and timely advice that we received from the Industrial Mathematics Study Group. Making the decision to invest in bringing elite specialist knowledge onboard changed the course of our venture in very beneficial ways, and we look forward to future opportunities to collaborate.*

**Eleanor Watson, Chief Executive Officer, Poikos**



For more information about Study Groups or to find out about the next event, visit [www.esgi.org.uk](http://www.esgi.org.uk)

# TakeAIM Competition

## Making mathematical thinking visible



The Smith Institute's annual TakeAIM competition is an opportunity for university students to showcase their work on the industrial stage. From medicine to manufacturing, security to social media, TakeAIM's goal is to highlight the crucial role mathematics plays in real-world problems while rewarding the academic exploration of future innovators who undertake this crucial research.

## TakeAIM 2016 Winners



Linnéa C. Franßen

### Using mathematics to outsmart cancer

Cancer kills about 8 million people worldwide yearly — and this does not even account for the suffering many go through when fighting the disease at some point in their lives!

In recent years, new technology has allowed us to gather vast amounts of data on cancer and to gain insight into its complex mechanisms of evolution, which has resulted in great advances in the treatment of some cancer types. Many of the over 200 forms of cancer, however, are still poorly understood due to the genetic complexity of the deadly disease. In particular, the cancer cells' ability to adapt to their environment over time and thus become resistant to treatments applied still poses an unsolved challenge.

My research at StAMBio focuses on this very problem: it looks at the interaction between cancer cells and their environment in order to predict how they may adapt to it over time by genetic change. My computational model is aimed to become part of a complex spatial multi-scale model. Our research group's aim is to gain an understanding of the mathematical rules driving cancer's evolutionary process to then be able to anticipate its next move and 'outsmart' it with case-specific treatment.

Unravelling cancer's complexities by using mathematics — the 'language of science' — together with advances in medical technology opens up new ways of finding optimal treatment for an individual's particular health issue. Our future vision is to individually tailor treatment to patients, making it gentler and more effective for those who need help most urgently.



Nicholas H. L. Wong

### Differential equations to prevent the internet capacity crunch

Whether we realise it or not, we use optical fibres everyday. Our emails, status updates, online videos, and websites are shuttled around the internet as light signals. The demand for internet capacity is expanding exponentially with the explosion of new capacity-hungry services e.g. cloud computing, social networking, and live high-definition video streaming, and also with more people becoming connected. While technologies have thus far kept up, this could change in this decade, when demand inevitably surpasses current fibre capacity limits — this means slower downloads for everyone. How can we overcome this 'capacity crunch'?

Recently, researchers searching for more capacity are studying a hitherto untapped channel: modes. Every optical fibre has a 'wave equation' which yields a discrete set of solutions called 'modes', each of which can theoretically support one communications channel, somewhat like how FM radio uses different electromagnetic frequency channels within the same atmospheric link. Although modes should ideally travel independently, in reality, they couple (mix) with one another due to various fibre imperfections, leading to undesirable channel interference. Previous fibres were thus deliberately engineered to support only one mode (i.e. 'singlemode').

My research aims to develop a model to study the mode coupling behaviour in new 'multimode' fibres. It involves using a powerful mathematical tool, namely coupled partial differential equations, to simulate the optical phenomena at play. With this, we can improve fabrication processes or discover better ways to robustly communicate using multiple mode-channels despite coupling, and hopefully increase capacity to ultimately preserve internet growth for future generations.

## The journey continues

*We caught up with previous winners to discover how TakeAIM made a difference to their research*

### Nicholas H.L. Wong

With his absorbing entry, 'Differential Equations to Prevent the Internet Capacity Crunch' Nicholas was one of two TakeAIM winners from 2016. His research into multimode optical fibres to tackle internet capacity for future generations captivated the judges at every stage of the competition. He has since expanded upon his studies to complete his postgraduate degree and submit his thesis.

With Mr. Wong's primary focus of study in engineering, he found the platform of TakeAIM 'enlightening' as professionals outside of his discipline, optoelectronics, became rivetted by his research. He added: "My work had never been presented in a forum such as this. It gave a new confidence in presenting my work to academics and non-academics. The intellectual and industrial interest shows that it has real value. I also discovered that there is a vibrant mathematics community out there currently tackling many real-world applied problems".

With a new-found confidence following TakeAIM and as he awaits graduation, Nicholas is looking forward to pursuing post-doctoral work or securing a position in industry. Nicholas summarised the impact the competition had on his studies and professional development: "the interest drawn from academic and industrial communities gave me confidence that what I was doing was worthwhile and I am grateful for the generous investment from the sponsor companies".

### Sponsors



### Justice Aheto

The now Dr Justice Aheto was one of the winners of the Smith Institute's TakeAIM competition in 2015 with an entry that strove to aid the poorest communities in Ghana.

A native of Ghana, Justice's entry addressed the alarming statistics on child malnutrition and using statistical models examined malnutrition prevalence and its determinants among children under 5 years old in the West African country.

When asked about the impact TakeAIM had on his studies Dr Aheto said; "TakeAIM provided me the needed springboard to excel in my research and to showcase the importance of my research as well as the crucial role mathematical and statistical modelling is playing in everyday life". Upon winning the competition his research gained an impressive assortment of media attention, most notably from the BBC World Service who broadcast a radio interview with Justice.

With the importance of his work illuminated by TakeAIM, Justice has since published a second paper on chronic malnutrition amongst children under the age of 5. He has now relocated to Ghana to take up a Biostatistics lectureship appointment at the School of Public Health, University of Ghana, Accra and is collaborating with other experts in nutrition and health to conduct researches into nutrition and health outcomes.

Summarising his experience of the competition, Justice commented: "This experience means a lot to me because it reminded me that one should make the best and maximum use of his or her expertise to contribute meaningfully to solving challenges facing society and that such efforts will not go unrecognised by society or organisations like the Smith Institute for Industrial Mathematics and System Engineering."

# Smith Institute Council

Responsible for guiding strategy, the Council is a vital asset to the Smith Institute and the work we conduct. The Council, as our Board of Directors, is a group of both senior management and experts in the field who are focused on the well running of the company and its future direction and growth.

The most recent appointment to Council, in February 2016, was Graeme Hobbs. With a background in the design and deployment of large scale radiocommunication systems, Graeme was Chairman of Motorola Solutions UK and head of Government Affairs for Europe, Middle East and Africa. Graeme is also a Chartered Engineer and a Fellow of both the Royal Academy of Engineering and the Institution of Engineering and Technology.

Reflecting on his first year on the Council, Graeme says,

*The Smith Institute is able to help customers by utilising the Scientific Board and its close relationship with academia to provide highly differentiated capabilities and solutions. The company structure is small and nimble, yet having the Universities of Oxford and Cambridge as Company Members really sets it apart.*

*The Institute can also identify new compelling market opportunities and help clients understand how industrial mathematics and system engineering can reduce costs and implementation cycle times to enable them to stay ahead of the competition. Above all, the skills and capabilities of our employees lead to the reputation it has earned over many years of successfully helping clients.*

*The Institute is continuing on its journey of the latest business thinking, processes and techniques to support its growth plan as well as developing its employees' skills and capabilities to be able to tackle the new business challenges.*

# Council Members



**Dr Bruce Smith**  
President of the Smith Institute and Chairman of its Council

Bruce is a Fellow of the Royal Academy of Engineering, the Institution of Engineering and Technology and the Institute of Physics. He is a director of a number of private companies, and a Domus Fellow of St Catherine's College, Oxford.



**Dr Heather Tewkesbury**  
Chief Executive Officer

Heather holds a PhD in modelling heat transfer from the University of Birmingham. She is a Chartered Mathematician, Fellow of the Institute of Mathematics and its Applications and a member of the Advisory Board for Warwick University's MathSys CDT.



**Dr Lincoln Wallen**  
Non-Executive Director

Lincoln is Chief Technology Officer at DreamWorks Animation. His early career involved 20 years of professional IT and mathematics research, including two years as BP Venture Research Fellow at the University of Texas at Austin, and latterly as a Reader in Computer Science at the University of Oxford.



**Professor John Ockendon**  
Chief Mathematician

John is Founding Director of the Oxford Centre for Collaborative and Applied Mathematics (OCCAM). He is also Emeritus Fellow of St Catherine's College, Oxford and a Fellow of the Royal Society.



**Dr Robert Leese**  
Chief Technical Officer

Robert holds a PhD in mathematical physics from the University of Durham and has been a Fellow of St Catherine's College, Oxford, since 1993. He is also a Fellow of the Institute of Mathematics and its Applications and a member of the Peer Review College of the Engineering and Physical Sciences Research Council.



**Mr Graeme Hobbs**  
Non-Executive Director

Graeme is the former Chairman and Government Affairs Lead (Europe and Africa) of Motorola Solutions UK Ltd. He is a fellow of both the Royal Academy of Engineering and the Institution of Engineering Technology. Graeme was recently elected as a trustee of the IET and is a visiting professor at the University of Bristol.



**Professor Nigel Peake**  
Non-Executive Director

Nigel is Professor of Applied Mathematics and Head of the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge. He is an Associate Editor of the Journal of Fluid Mechanics and co-Director of the EPSRC Centre for Doctoral Training in Analysis at Cambridge.



**Mr David Miller**  
Finance Director

David is a Chartered Accountant and focused on assisting growing companies. He qualified with Ernst & Young and then moved to Gillette, rising to Finance Controller in one of the UK divisions.



**Dr Bob Whelan**  
Non-Executive Director

Bob is a former non-executive director of NPL Management Ltd and Director of the Institute for Prospective Technical Studies of the European Commission in Seville. He was founder Director of CEST, the Centre for Exploitation of Science and Technology and has 20 years' experience of new product and process development with PA Technology, Cambridge.

# Scientific Board



**Dr Keith Winters**  
Co-Chairman of the Scientific Board

Keith is a Fellow of the Institute of Physics and the Institute of Mathematics and its Applications. He is also an Honorary Professor of the School of Mathematical Sciences at the University of Nottingham.



**Professor John Ockendon**  
Chief Mathematician and Co-Chair of the Scientific Board

John is Founding Director of the Oxford Centre for Collaborative and Applied Mathematics (OCCAM). He is also Emeritus Fellow of St Catherine's College, Oxford and a Fellow of the Royal Society.



**Professor Kevin Glazebrook**  
Distinguished Professor of Operational Research (OR) at Lancaster University

Kevin currently holds a joint appointment between the Departments of Mathematics and Statistics (Faculty of Science) and the Department of Management Science (Management School). Kevin is the Chair of the Research Panel of the Operational Research Society.



**Professor David Abrahams**  
Director, Isaac Newton Institute for Mathematical Sciences

David was formerly President of the Institute of Mathematics and its Applications. He has published extensively in the areas of fluid/structural interactions, non-destructive evaluation, fracture mechanics, electromagnetism, water waves and seismology.



**Dr Jakob Blaavand**  
Mathematical Consultant

Jakob completed his DPhil in differential and algebraic geometry at the University of Oxford. He taught undergraduates at both Oxford and Aarhus University Denmark, for a total of 7 years.



**Professor Alan Champneys**  
Professor of Applied Non-linear Mathematics and Head of Queens School of Engineering at the University of Bristol

Alan completed his DPhil in Mathematics at the University of Oxford, moving on to work as a Postdoctoral Research Assistant in the School of Mathematical Sciences, University of Bath. Before becoming a Professor, he was awarded an EPSRC Advanced Fellowship.



**Dr David Allwright**  
Mathematical Consultant

David holds a PhD in Mathematics from the University of Cambridge and worked as a Research Fellow on control theory at the Universities of Cambridge and Toronto.



**Professor Richard Craster**  
Professor of Applied Mathematics at Imperial College

Richard holds visiting professorships at the University of Alberta, Brunel University and an invited professorship at the University of Aix-Marseilles.

# President and Vice Presidents



**Professor Mark Girolami**  
Director, Data Centric Engineering at The Alan Turing Institute

Mark holds an honorary professorship in Computer Science at the University of Warwick. He is an EPSRC Established Career Fellow and was previously an EPSRC Advanced Research Fellow. Mark is also Honorary Professor of Statistics at University College London and is the Director of the EPSRC funded Research Network on Computational Statistics and Machine Learning.



**Dr Bruce Smith**  
President of the Smith Institute and Chairman of its Council

Bruce is a Fellow of the Royal Academy of Engineering, the Institution of Engineering and Technology and the Institute of Physics. He is a director of a number of private companies, and a Domus Fellow of St Catherine's College, Oxford.



**Lord Julian Hunt**  
Vice President

Julian is the former Director General and Chief Executive of the British Meteorological Office. He is Professor of Climate Modelling in the Department of Space and Climate Physics and the Department of Earth Sciences at University College London.

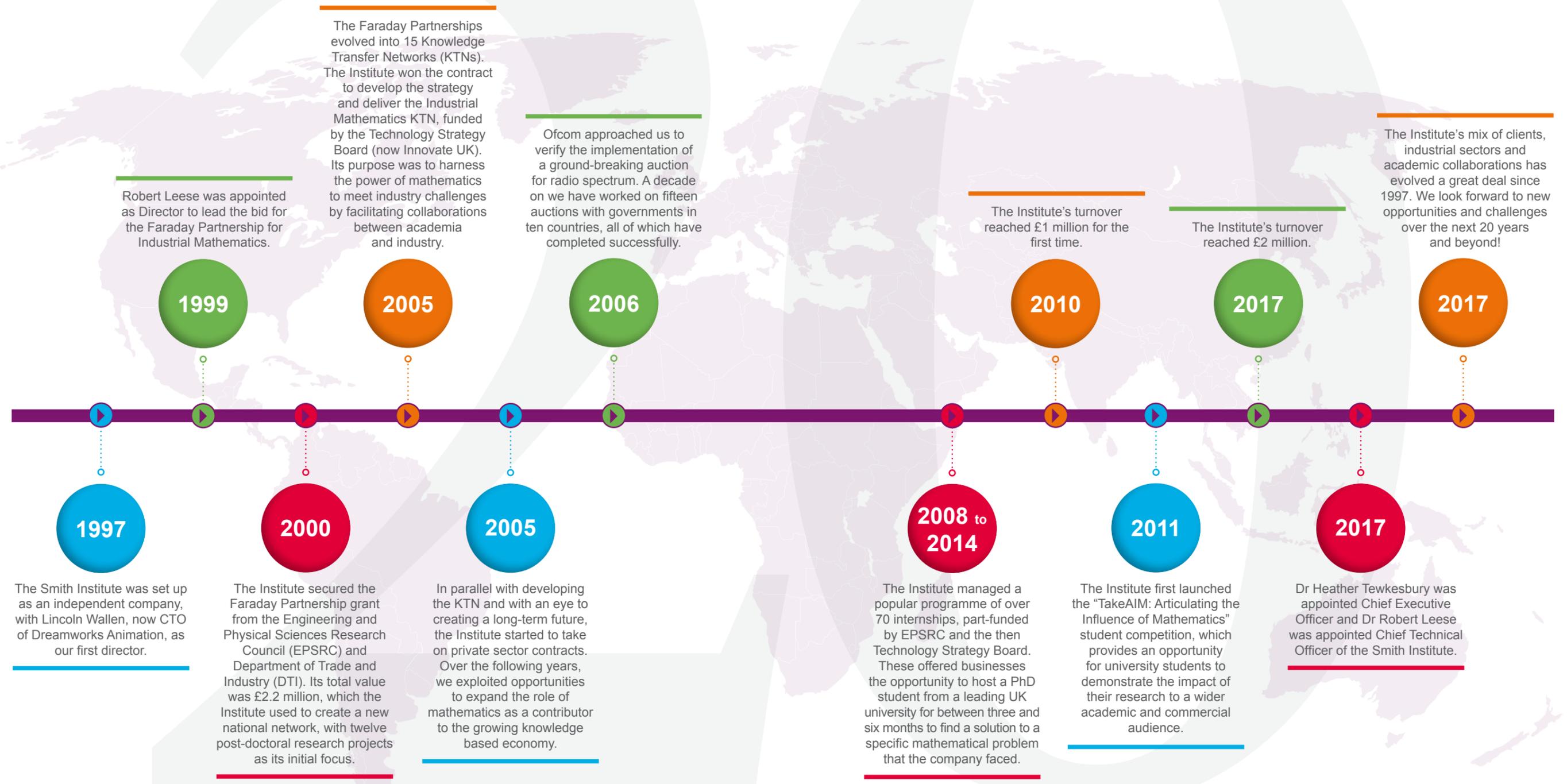


**Professor Frank Kelly**  
Vice President

Frank is a Professor of the Mathematics of Systems at the University of Cambridge. He is a Fellow of the Royal Society, a Foreign Member of the National Academy of Engineering, and in 2013 he was awarded a CBE for services to mathematical sciences.

# 20 Years of the Smith Institute

Our President and Founder, Dr Bruce Smith, formed the Smith Institute initially as a division of Smith System Engineering Ltd. In 1997 Bruce sold Smith System Engineering and set up the Smith Institute as a company in its own right.





**Smith** *institute*  
for industrial mathematics and system engineering

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