Second 'Uncertainty Quantification & Management' Study Group

This Study Group aimed to address broad challenges in Uncertainty Quantification & Management (UQ&M) by tackling four industrial problems supplied by Airbus, Manufacturing Technology Centre (MTC) and Rolls-Royce. Members of the UK research base were invited to Liverpool in March 2017 to join Study Group organised by the UQ&M Special Interest Group (SIG) and the Institute for Risk and Uncertainty. The Group focused on four real-world problems. Four teams of industrialists: one from Rolls-Royce, two from Airbus and one from MTC came with challenges, and members of the UK research base were invited to attend for three days to work on them.

We were also delighted to have Prof John Ockendon FRS deliver a pre-dinner talk on the history of Industrial Mathematics in the UK, Study Groups and in particular the trends of industrial problems over the decades. His academic career has been built around mathematics-in-industry, beginning with the first ever Maths-in-Industry Study Group in 1968.

The format of the workshop, with coffee breaks and working dinner, stimulated a lot of interesting discussions on uncertainty and risk communication. The Study Group served the purpose of addressing industrial challenges in an open, interactive forum, sharing methods and techniques, exploring the real issues to be tackled and providing evidence, by means of written reports, for the necessity for such approaches to be of real benefit to all those who attended. istudygroup.riskinstitute.org.uk

riskinstitute.org.uk
Second ’Uncertainty Quantification & Management’ Study Group with Industry

Marco De Angelis¹, Matt Butchers², Alejandro Diaz³,

The enthusiasm that followed the success of the first UQ&M Study Group with industry led to the Second gathering just a few months later. Once again the Study Group (SG) was hosted in Liverpool at the Institute for Risk and Uncertainty, home of the EPSRC/ESRC Centre for Doctoral Training in Risk and Uncertainty.

This year four case studies supplied by Airbus, Rolls Royce and MTC (the Manufacturing Technology Centre) were presented. To know more about these problems please visit the webpage: iistudygroup.riskinstitute.org.uk.

The Group had four main purposes: 1) to support companies with established UQ programmes refine their approaches, 2) help companies new to the field understand the benefits that UQM could have on their operations, 3) to expose UK researchers to the kind of challenges in which UK industries wish to apply UQM to, 4) to enable cross fertilisation of ideas between disciplines, such as data science, statistics and numerical analysis.

This Study Group represents a vital part of the Special Interest Group (SIG) effort in identifying state of the art approaches to deal with industry problems, and to sense where there are UK strengths and weaknesses. Ideally, the Group’s output will be of direct value to these industries posing specific problems. But also from the approaches generated, wider industries can gain a sense of collecting ‘good practice’ in an industrial context.

The format of the event followed the highly successful European Study Groups with Industry. Industries presented their problems in the morning of the first day to the wider group. The researchers asked questions and chose the problem they were able to help on.

After the morning presentations, each industrial problem was allocated to a group of researchers, who then moved to their own working space. Academic Project Leads were nominated, to discuss with each group what aspects of their problem should be addressed, and how these may be approached. Some of the groups subdivided, to better focus on some specific aspects of the problem.

The industry representatives were also collaborative in answering questions about the problems, providing access to codes, data and generally ensuring that the problem context was clear throughout the event. The conversations continued during the evening dinner that was provided to all delegates.

Group work continued until the last afternoon put aside for final presentations. The Project Leads and some other key researchers delivered these presentations to the all delegates. Following the Study Group, the industry presenters will receive a report detailing what was done during the three days. After review by each industrialist, these reports will be made public.

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University Public Lecture - Opening the Series on Risk & Uncertainty with DSTL - 24th April 2017

Dr Veronica Bowman, Honorary Fellow Research Scientist at the Institute for Risk and Uncertainty

'Calculating and Communicating Uncertainty and Risk to Allow Informed Decision Making'

Clear communication of uncertainty is crucial for effective risk management, but is difficult to achieve in practice. This is compounded when the application area is complex and accurate calculation of uncertainty is both challenging and time consuming.

Uncertainty communication must be clear to experts and non-experts alike and must account for a lack of understanding of the definitions of both "risk" and "uncertainty". This talk examined the underpinning principals of how risk and uncertainty is understood and communicated, delivering examples from a wide variety of defence applications that require an understanding of uncertainty and outlining the reason why uncertainty calculation and communication is crucial to decision making.

The talk then provided an illustrative scenario examining the theoretical release and spread of a disease within a city, demonstrating both the challenges faced in such a complex scenario and sharing current best practice when communicating with decision makers.

About Ronnie:

Dr. Veronica Bowman is a principal statistician at the Defence Science and Technology Laboratory (DSTL). She specialises in uncertainty calculation and communication as well as Bayesian inference. She has spent many years applying Bayesian methodologies and data fusion techniques to problems in the military domain, as well as working with academia to improve understanding of how uncertainty is propagated and how decisions should be taken under uncertainty.

Dr Bowman is internationally recognised as the lead technical expert for Chemical, Biological and Radiological (CBR) knowledge management. She was the chair of the Calculating and Communicating Uncertainty Conference (CCU 2015), which brought together leading researchers from the field of uncertainty, and has authored a chapter on communicating uncertainty in the Risk Management Handbook.

Veronica has a BSc with First Class Honours and a PhD in Statistical Modelling both from the University of Southampton. She is a Fellow of the Institute of Mathematics and its Applications and is a Chartered Mathematician, and now a Fellow of the Institute for Risk and Uncertainty.

About the Risk Lecture Series: As part of the effort to connect research in the Institute with prominent organisations, and to contribute to University's ongoing efforts in reaching out to the general community, an Open Lecture Series in Risk and Uncertainty is taking place in 2017. High-profile speakers from government, industry and academia have been invited to deliver public talks in the evenings.

These take place in the Leggate Lecture Theatre in the Victoria Building on the University of Liverpool campus at 5.30pm.

https://www.liverpool.ac.uk/risk-and-uncertainty/risklectureseries/ronnie/
About the Event
This year the event took place in Liverpool, at the Central Teaching Laboratories, right at the start of the Easter academic season. The workshop was attended by more than 70 people, which included our core CDT, Master’s Students and other users from several other national and international companies and academic organisations from Spain, Belgium, France, Germany, Italy. The material of the course, including the videos are available on stream.liv.ac.uk using the search keyword “COSSAN”. See cossan.co.uk for more information.

Structure of the Training Programme
The structure of the training this year was slightly different, as the High Performance Computing (HPC) session was taught at the end of the course, to provide a better link to the contents of the previous two days toward applications and to extend the scope of the workshop. On day one an introduction to the GUI and to the engine of the Cossan software was provided followed by an hands-on session, while on day two the whole session was spent in the Lab to practice on Tutorial examples.

Aims and Learning Outcomes
The users have been taught the state of the art of UQ&M methods and approaches and how these can be used on real-world applications with the aid of High Performance Computing. The participants walk away with a toolkit of efficient methods for uncertainty quantification to be used for their projects. http://cossan.co.uk/training/training_UQ2017.php

Next meeting
MARCH 2018
Easter School 2017, in collaboration with the Institute of Financial and Actuarial Mathematics (IFAM) of the University of Liverpool
18th to 21st April 2017, Liverpool, UK

About the Event: This year the Easter School has had a busy schedule. The School opened on the Tuesday 18th of April, with Professor Jean Lemaire from University of Pennsylvania, USA, who talked about Probability Distributions used in Motor Insurance, and then continued in the afternoon with talks from Prof Bojan Basrak from University of Zagreb, Croatia, who talked about Risk Applications in Point Processes. On day two, Dr James Cheshire held an interactive sessions on Data Visualisation, where participants were split into working groups and assigned a small visualisation challenge. The formed grouped responded very well and under the guidance of the teacher, they came up with some interesting results.

On day three, after two more sessions on Point Processes by Prof Basrak, the School hosted Prof Steve Haberman from City University in London, who talked about Longevity trends, Modelling and Forecasting, which was very well received by the audience. The day’s intense activities were then followed by a dinner in a local restaurant, where everybody enjoyed some relaxing time.

On day four, the last day, the School ran two parallel sessions: one session on Sensitivity Analysis by Dr Elmar Plischke from TU Clausthal in Germany, and one session on the Bonus-Malus System in Car Insurance by Prof Jean Lemaire. The session on Sensitivity Analysis continued in the afternoon with some hands-on activities in the computer room.

The Easter School closed on the Friday 21st April with the practical session on Sensitivity Analysis, which was followed by a fantastic 5-aside football tournament, attended by both students and staff. http://riskinstitute.org.uk/easterSchool2017/

Cohort 3 visit to UoL’s London Campus and Lloyd’s Register
3rd to 4th May 2017, London, UK

Cohort 3 Students in London MRes students with LFB Officer On the Roof-top of UoL Campus in London
**Pint of Doom Night @ The Pint of Science Festival**

The Baltic Social, 7:30pm - 9:30pm 17th May 2017, [https://pintofscience.co.uk/event/pint-of-doom](https://pintofscience.co.uk/event/pint-of-doom)

From within our Centre for Doctoral Training, a small group of students made of social scientists and technical enthusiasts, organised a very successful event to showcase student research projects across all year a very unusual venue: a local pub.

The 'Pint of Doom' took place in the Baltic Social, a pub at the centre of the Baltic Triangle, in the Creative Quarter of Liverpool based in the city centre, on May 17th, a Wednesday evening.

The event was organised in response to the pressing need expressed by the Research Councils (EPSRC/ESRC) to make contact with the general public. Indeed, this was a unique opportunity for our Centre to engage with external and non-academic people, in a chilled and diverse environment, such as the pub. The event gave students the opportunity to speak, answer questions and gain feedback from the wider audience.

The Baltic Social was fully booked, with more than 70 tickets, in just over two weeks before the event. In between each talk, our first year PhD student Dominic Calleja, entertained the audience with the popular Risk Quiz which made everybody comfortable and ready for some pints of science.

Topics touched on during the talks were: terrorism, post-truths, climate change, antimicrobial resistance, nuclear weapons and unstable financial markets. Our 'Pint of Science' catalysts (Main Acts) were from:

- **Prof Scott Ferson** (Chair in Uncertainty in Engineering): *Combating Gullibility*
- **Simon Clark** (PhD Student): *Floods*
- **Jodie Barber** (MRes Student): *A return to the pre-antibiotic era: A real possibility?*

Other speakers, who talked for a shorter time (Shots of Science) were PhD students Sara Owczarczak-Garstecka, Maria Mendoza-Puchades, Dominic Calleja, Leona Vaugh, and MRes student James Butterworth. The latter student, James, was awarded the prize for the best Shot of Science of the night.

“The Doomsday Clock is 2.5 minutes to midnight. Do we stand a chance? The researchers from Liverpool’s Institute for Risk and Uncertainty work to understand and tame the risks that surround us. This event is to learn more about their work, play the Risk Quiz and win Pint of Science goodies!”

This has been the very first Pint of Science in Liverpool and it has been brought to the city jointly by the University of Liverpool and Liverpool School of Tropical Medicine.

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*Sara Owczarczak-Garstecka, Simon Clark, Dominic Calleja, Maria Mendoza-Puchades*
Awards and Recognition

Congratulations to Alfredo Garbuno and Antonios Meimaris, who won respectively the First and Second prize awards for their original solutions to the UQ February Challenge.

Congratulations to Roberto Rocchetta, Hindolo George-Williams, Jonathan Sadeghi and Marco de Angelis for winning the first prize in this year’s Mathematical Challenge, awarded by the Society of Mathematical Calculus and by the French Federation of Mathematical Games. This year’s challenge was entitled: “From the Earth to the Moon”; more details about the proposed solution can be found here.

Congratulations to Dr Roberto Ferrero (EEE), who was awarded in March the Early Career Researcher and Returners Fund grant for a total of £2,268 to kick start a project on prediction of batteries life-time using inexpensive technologies in collaboration with other Early Career LIRU’s researchers.

Important Dates

Open Lectures on Risk and Uncertainty

As part of the effort to connect research in the Institute with prominent organisations, and to contribute to the University’s ongoing efforts in reaching out to the general public, Prof Roger Street from University of Oxford, leader of the UK Climate Impact Programme, will speak within the Open Lecture Series on June 14th 2017.

The lectures would take place in the Leggate Lecture Theatre in the Victoria Building on the University of Liverpool campus at 5.30pm followed by a wine reception and a dinner in honour of the speaker. The next speaker will be Alex Brazier, from the Financial Stability Strategy and Risk department of the Bank of England. This public lecture will take place on July 24th, 2017.

Wednesday 14th June, 5.30pm 2017: Open Lecture on Risk and Uncertainty, Prof Roger Street UK Climate Impact Programme, University of Oxford. Victoria Gallery & Museum (map), Leggate Theatre.

Mon 11 - Fri 14 July 2017: 1st Annual Conference On Decision Making Uncertainty University of Exeter, Exeter EX4, UK (map)


Thursday 21st September 2017: Risk CDT Annual Showcase Conference 2017, followed by CDT Board Meeting with stakeholders and EPSRC.

Friday 22nd and 23rd September 2017: Bayes Days, Overcoming practical problems in applying Bayesian methods, Institute for Risk and Uncertainty, University of Liverpool, UK.

Wed 13 - Fri 15 December 2017: Third Uncertainty Quantification & Management (UQ&M) Study Group with Industry, in collaboration with KTN Innovate UK, at the University of Warwick.


Important Links

Risk Institute Calendar: http://riskinstitute.uk/calendar/
Reliable Engineering Conference (REC2018): http://www.rec2018.uk
Risk CDT website: http://www.liru-cdt.org/
Risk Institute University website: https://www.liverpool.ac.uk/risk-and-uncertainty
New Student Projects

Risk CDT Cohort 4: Student Projects starting in October 2017

- **Uncertainty quantification in fusion power plant design.** *Student:* Max Morgan (Physics). *Supervisors:* Dr Edoardo Patelli, Engineering; Dr Hanni Lux, Physics and Computational Science. *Industry Partner:* Culham Centre for Fusion Energy (CCFE)

- **Adolescent cannabis:** Mapping risk factors and neurodevelopmental trajectories using multimodal imaging, cognitive and genetic data. *Student:* Mollie Neason (Biomedical Sciences). *Supervisors:* Dr Valentina Lorenzetti, Psychology; Dr Marco de Angelis, Engineering. *Partner:* Behavioural Insights Team (BIT)

- **Iceberg calving and glacier retreat in populated fjords: past, present and future risks.** *Student:* Dominik Fahrner (Geology). *Supervisors:* Dr James Lea, Environmental Science; Dr Clare Downham, Institute of Irish Studies; Dr Douglas Mair, Geography. *Industry Partner:* Asiaq Greenland Survey

- **Uncertainty and risk in the deployment of additive manufacturing produced structures in the aerospace industry.** *Student:* Alexander Wimbush (Engineering). *Supervisors:* Dr Peter Green, Engineering, Dr Kate Black, Engineering. *Industry Partner:* Renishaw

- **Multi-source flu surveillance.** *Student:* Conor Rosato (Computer Science). *Supervisors:* Prof Simon Maskell, EEE&CS; Prof Sarah O’Brien and Dr John Harris, Institute for Global Health. *Industry Partner:* Defence Science and Technology Laboratory (DSTL)

- **Advances in financial risk analysis, modeling and management.** *Student:* Nestoras Chalkidis (Mathematics). *Supervisor:* Dr Athanasios Pantelous, Mathematical Sciences. *Partner:* Acanto Research (Germany)

- **Understanding the risks associated with the design and construction of large particle accelerators.** *Student:* Damien Colette (Physics & Engineering). *Supervisors:* Dr Anas Batou, Engineering; Prof Carsten Welsch, Physics. *Industry Partner:* Science and Technology Facility Centre (STFC)

- **Realistic model prediction for managing risk in nuclear decommissioning.** *Student:* Matthew Stock. *Supervisors:* Sven Schewe, Computer Science; Dr Edoardo Patelli, Engineering, Prof Michael Fisher, Computer Science. *Industry Partner:* National Nuclear Laboratory (NNL)

- **Development of metrics for the fidelity assessment of the human-machine interface in flight sim applications.** *Student:* Josephine Roscoe (Engineering). *Supervisors:* Dr Mark White, Engineering; Dr Georg Meyer, Psychological Sciences. *Industry Partner:* BAE Systems

- **Understanding epistemic uncertainty captured in seismic hazard assessments for critical infrastructure.** *Student:* Antoine Delvoye (Geosciences). *Supervisors:* Dr Ben Edwards, Earth Ocean & Ecological Sciences; Dr Edoardo Patelli, Engineering. *Industry Partner:* Arup

- **Precision bioengineering of surfaces in healthcare**

  *Student:* Mark Briggs (Chemistry). *Supervisors:* Professor Rasmita Raval, Chemistry; Dr Daimark Bennett and Dr Heather Allison, Institute of Integrative Biology. *Industry Partner:* DePuy Synthes

- **Improved detection of drug-drug interaction.** *Student:* Elpida Kontsioti (Pharmacy). *Supervisors:* Prof Simon Maskell, (EEE&CS); Prof Sir Munir Pirmohammed, Molecular and Clinical Pharmacology. *Industry Partner:* AstraZeneca

- **High-throughput component testing and certification for additive manufacturing.** *Student:* Liam Doyle (Engineering). *Supervisors:* Prof Chris Sutcliffe, Engineering; Peter Green, Engineering. *Affiliations:* Centre for Doctoral Training in Additive Manufacturing, Renishaw

- **Data and risk analysis of European pensions systems for survivors.** *Student:* Kira Henshaw (Mathematics). *Supervisors:* Dr Corina Constantinescu, Mathematical Sciences; Prof Sandra Walklate, Sociology. *Industry Partner:* Charles Oddy, Enterprise Risk Management Consultant

- **From uncertainty to risk? Cytotoxicity mechanisms of antibiofilm nanoparticles.** *Student:* Adam Guiness (Biomedical Sciences). *Supervisors:* Dr Rachelle D’Sa, Engineering; Dr Paolo Paoletti, Engineering. *Industry Partner:* Innovenn Ltd.

Acknowledgements:
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