Knowledge Exchange Community Meeting 2017
Industrial Maths in Action
Version 2 – Correction of Participant Affiliations

This report is a write up fo the KE Community Meeting held at ICMS, in September 2017. It aims to capture the main themes and discussions as well as detail the actions arising from the meeting.

Meeting Aims

1. Provide an update on the UK KE review and an opportunity for the community to comment/contribute
2. Share examples of good practice knowledge exchange
3. Provide an opportunity for hands-on experience of a *good practice* KE activity (mini-study group on Day 2)
4. Offer a forum for discussion and networking

The meeting organisers were grateful to the organisations (listed below) who provided financial support which enabled this meeting to be held.

- The Knowledge Transfer Network (KTN)
- Engineering and Physical Sciences Research Council (EPSRC)
- Maths for Industry Network (MI-NET)
- European Consortium for Maths in Industry (ECMI)
- Bath Institute for Mathematical Innovation (IMI)
- Institute of Mathematics and its applications (IMA)

This report aims to capture the contents and discussion of the day

Summary of themes and topics

- Knowledge Exchange review is an exciting opportunity for the community. Input and feedback is very welcome. Review is now entering the write up/recommendations phase.
- Importance of inclusivity mathematical sciences for the whole community (including statistics and OR)
- Attendees were keen on the idea of central place/hub that could be an initial place to contact
- Importance/value of study groups to the community was highlighted.
- Mini-study groups, showcased on Day 2, are an interesting options for academia/industry interaction.

The next steps are predominantly to make the contact from this meeting available and feed into the review. Once the review is completed, there will be an opportunity to reflect and consider actions moving forward.

List of Participants/Distribution List

Last Name	First Name	Institution
Abrahams	David	INI
Bleak	Collin	University of St Andrews
Bond	Philip	University of Bristol
Budd	Chris	University of Bath
Burke	Sinead	Mathematics Applications Consortium for Science and Industry (Macsi)
Butchers	Matt	Knowledge Transfer Network
Champneys	Alan	University of Bristol
Connor	Joseph	Experto Crede
Corson	Stephen	University of Strathclyde
Creagh	Stephen	University of Nottingham
Evatt	Geoffrey	University of Manchester
Fitch	Davey	University of Edinburgh
Flemming	Brian	Leonardo
Foulon	Patrick	CIRM Luminy
Glendinning	Paul	ICMS
Hall	Julian	University of Edinburgh
Hemmings	Philippa	EPSRC
Hjorth	Poul	Technical University of Denmark
Joerg	Kalcsics	University of Edinburgh
Jordan	Joanna	Bath Institute for Mathematical Innovation
King	Steve	Rolls-Royce
Kosta	Dimitra	University of Glasgow
Kulesza	Kamil	University of Cambridge
Lacey	Andrew	Heriot-Watt University
Lee	William	University of Huddersfield
Leeks	Jane	Turing Gateway for Mathematics (TGM)
Leese	Robert	Smith Institute
Mcginty	Sean	University of Glasgow
McKee	sean	University of Strathclyde
Montibeller	Celine	CIRM Luminy
Mottram	Nigel	University of Strathclyde
Murtagh	Fionn	University of Huddersfield
Myers	Tim	Centre de Recerca Matematica
North	Stephanie	University of Cambridge
Ockendon	Hilary	OCIAM
Ockendon	John	OCIAM
Pearson	John	University of Edinburgh
Pembleton	Claire	University of Edinburgh
Pinch	Richard	GCHQ
Please	Colin	University of Oxford
Pratzel-Wolters	Dieter	Fraunhofer ITWM
Salisbury	Gavin	EPSRC
Strachan	Ian	Edinburgh Mathematical Society/University of Glasgow
Ward	Mike	EPSRC
Wasley	Dawn	ICMS
Wilson	Lorna	Bath Institute for Mathematical Innovation
Wilson	Stephen	University of Strathclyde

KE in Mathematical Sciences Review: Updates on Review Aims & Progress

Community Input Session

Phil Bond made a quick introduction to this session. Provided background and emphasised the importance in involving the correct people in the review. Mike Ward and Matt Butchers gave an overview of the process and some comments/themes emerging from the detailed questionnaires.

Delegates were then invited to comment on feedback received. A summary of the comments provided at the London meeting was available, and delegates provided input via the feedback template. These were collected over the course of the day and Gavin Salisbury, who is leading the write up of the review, will incorporate these into the review process.

Comments and issues raised at the end of this session included

- The need to consider cultural issues within the maths community
- Will the report detail specific KE mechanisms (e.g. Study Groups)
- Ensure the use of the word 'community' is broad in its definition – do not want to be seen as clique
- An aspiration should be to provide a route for Industry to engage.
- Recurring theme of improved 'branding' is required
- There is a recognised need for increased intra-disciplinary working – are the mechanism in place to make this happen?
- There needs to be an internal sell to the community
- Avoid Bureaucracy where possible – keep it simple

Managing the Industry-Academia Interface (Bridging the Gap)

Dawn Wasley - KE meeting 2015, RS meeting 2017

DW gave an overview of the KE community meeting in 2015, the resulting actions which have feed into the UK Knowledge Exchange discussed in the morning session. A brief update of the Royal Society, June 2017 meeting Maths for the Modern Economy was provided. There is a draft report for the RS meeting, once finalised this will be made available.

(Action – Finalise the RS report and make available, via appropriate website)

Robert Leese - Bridging the Gaps

(Action - Make talks from the day available via the website)

What could be done, What should be done, What will be Done 'turning the corner'

Dieter Pratzel-Wolters - Fraunhofer

- There had been a view that maths not compatible with Fraunhofer – but that has not proved to be the case. ITWM run like a standard Fraunhofer and **is** successful
- c.a. 50% industry funding
- Industrial Partners – 145 per annum – largely follow up/repeat business.
- 1/3rd of the income from outside Germany
- Financial autonomy (unless there are financial difficulties)
- Make good use of networks/clusters
- First 5 years, slow growth required lots of effort. Relatively long time to build momentum

Sinead Burke MACSI

Funded by Science Foundation Ireland. MACSI recently celebrated its 10 year anniversary.

Main Industry in Ireland – Medical Devices, Pharmaceuticals, Food and Drink.

Approx 70% government, 10% industry, 20% industry in-kind

Hub and Spoke model, typically staffed with Post docs (rather than PhDs) due to fast timescales

Hub – government funded

Spokes industry funded

Need balance size/cost. There is no buy out for teaching. Managing the workload/opportunities is a challenge. Going forward, need to give thought to size of projects and costing mechanisms.

Jo Jordan/Lorna Wilson - Bath IMI

Overview of Bath IMI structure and activities. Currently there are 3 research Associates.

Alumni have been a key source of contacts

A project that arose from the recent Agri-Maths KTN sponsored study group was highlighted.

Kamil Kulesza – Polish Academy of Science

Lion share of income is from industry.

The bureaucracy involved in grants off-putting

Maths finance is a busy area. Initial contracts are not very lucrative and relationships take time to develop. However building these relationships is worthwhile and lucrative in the long run.

Colin Please

IP issues – point for discussion

Is situation in UK different – appeared that UK people viewed it as more problematic?

KTP scheme – from a quick review only 6 of 637 projects appear mathematical. This looks like a scheme that is not being actively used by the community

2 maths CDT with substantial industry involvement. Oxford CDT – 4 years, current model would need to be changed for the long term. However, there is a big appetite within industry and lots of potential for exploitation. The CDT has been very successful for cohort building.

An overview of the different study group activities was given. *Do study groups now require some overarching co-ordination?*

Discussion Session

Hilary Ockendon (HO), John Ockendon (JO), Alan Champneys (AC), David Abrahams (IDA) formed the panel and provided some opening remarks.

Opening Remarks

JO: Industrial Maths. There are some attitudes that prevail. My view is that we won't be able to completely change that, but we can live with that. There are great individuals, and the discussions that there could be something to bring it together, 'a hub' are interesting. My view, is that one attribute of a hub, is it could be a mechanism to fund KE. Furthermore, it is vital that any 'hub' is impartial.

HO: It was interesting to hear Colin's comments on Study Groups. They have effectively stayed the same for 50 years, and are now beginning to vary – which is perhaps a reflection on how things are changing/progressing. We've also heard that there are many other ways of making contact – and views on how to co-ordinate those would be interesting. Would it be useful for Industry to have a menu of options available when they make an approach? An initiative like that is going to require central funding to get going. Additionally, MI-NET has some work underway, and is looking at compiling an industrial network page for infrastructure. One of the planned information resources is to pull together a description of the different mechanisms for Knowledge Exchange. Perhaps this could be made available to the wider community as a resource

Action : HO see if the MI-NET compiled information can be made available.

IDA: I share Colin's vision of joining the community together. There is a challenge to make best use of the CDTs. It would be nice to see some of the things happening in the CDTs roled out nationally. Personally, I believe ICMS/INI/TGM should be used to facilitate this. With the Bond Review, I wonder whether the training of UG/PG students will be covered. Promoting a sense of entrepreneurship. The comments that CDTs promote a culture where students are not scared to engage with academics is great to hear - this is vital. Internships

have a vital role/opportunity for ECR. Royal Society Industrial Fellowships need to be promoted/considered by the community. I believe the INI/TGM has the role of helping bring these communities together. With regard to the 'hub', I think of this a shop front. It needs a strong brand (cf Data Science and ATI) – so that people know what it is. I don't think it would replace existing infrastructure, but enhance what we have.

AC: Like others I am a fan of joining things together. We should view knowledge exchange as a mixed economy. We've heard some Best Practice examples today – lots of great things.

- Study Groups
- Undergraduates – work on real problems
- Fraunhofer – could that work in the UK?
- Centres such as MACSi have developed for industrial maths
- Use of Alumni– US/Fraunhofer
- Use of Intermediaries

We need to do all of this, but within an umbrella.

Bearing in Mind the Dowling Review

1) KE is a people sport
2) Sectors contribute 2%. So there perception is Maths KE 2% overall.

Where would we be without Maths – **NEED** to provide the evidence. Perception of 2% is at odds with the 16% GDP reported in the Deloitte report.

After the Discussion Session the floor was opened. There was lots of initial discussion around the idea of a hub. This report has attempted to organise the subsequent comments/discussion into themes. Where possible comments have been attributed. Unassigned comments are shown in square brackets.

Comments regarding the idea of a Central 'Hub'

Robert Leese (RL) - the concern is about not being able to commercialise scientific output (part of the reason behind Catapults). We need to make sure we 'do' the right thing. The risk is creating capability without linking it to requirements. Need to be careful when discussing a 'hub' as to who drives the requirement for this. A shop window on best practice sounds appealing – but careful consideration to thins such as governance is required

[Does UK Industry know what maths they want?]

[Role of 'hub' – bring together factions]

IDA – Needs a vision. In the past Industrial Maths KTN, oversaw internships – that worked well with strong community support

JO – A 'hub' could have a role which includes co-ordinating projects

AC - Could look like Fraunhofer from the outside but not have the full extent on infrastructure – have the ecosystem/network

[Important to be able to buy time.]

Andrew Lacey (AL): Do we have the right expertise within the existing community? Do we know where to find the correct expertise?

Sinead Burke (SB): Would industry be expected to input?

Paul Glendinning (PG): Need clarity on what is meant by community. Industrial maths – vs whole of the maths community. It should be wide ranging and inclusive. Consider what is needed over the short term (e.g. next 2 years) and what the end result could be. Start small and then grow. There needs to be lots of drivers – for attitude change to happen.

JO - funding needed to enable this.

IDA – Has to be the whole of maths! Anyone from Maths should be able to get involved

[Manchester it has been possible for the whole department to become involved. Probably due to the people at Manchester] IDA –the 'hub' would/could enable the people to allow other areas to achieve this too.

[Fraunhofer is a private public partnership, ATI is following a similar model.]

Jane Leeks (JL): a 'hub' or similar will require pump prining to get if off the ground. KE is a people intensive business. It requires a lot of resource, and we need more people helping to facility this. We need to grow the KE activity – and we need people with the right skills so it can be done properly.

[need to be mindful of any data protection issues]

HO: Would the Smith Institute be an appropriate model to consider?

[Other models mentioned were the old KTN and MITAX]

JL other activities across the UK e.g. Bath IMI, Strathclyde, KTN etc should be included

AC- Governance and Conflicts of Interest need to be considered.

JO – Impartiality is vital.

RL: long term with public funding needs a sustainability plan from day 1. Needs careful consideration.

Steve King (SK): From an Industry perspective you want very clear terms of reference from the outset.

RL: connect capability. Get industry to define the Terms of Reference

<u>Other Comments/Topics</u>

IP

AC – would a standard contract for doing 'Industrial Maths' be a useful things. *Comments on the day – were if such a thing could be agreed – that would be very useful.*

Kamil Kulesza (KK) – it can work. Results of maths research, Don't own the IP but has rights back

[Emphasis on D of R&D. Help manage and foster long term to progress through the TRL, and standard IP could help**]**

Cluster/Network Model

Fraunhofer wants and needs underpinning governmental support. For industry we look for letters of support and similar. With Brexit there is some uncertainty but as Brussels provides supports for Clusters/Networks perhaps something similar with a UK focus. The head of the UKRI has initiatives, e.g. ISCF. It could perhaps consider/support a Cluster/Network type model.

Action Summary

Who	**What**	**When**
Gavin Salisbury	Incorporated the feedback from Day1 morning session into the Review	Report due Dec 2017
Dawn Wasley	Write up of this report, distribute to participants and feed to UK review (if appropriate)	By early/mid October.
Dawn Wasley	Make slides available via ICMS website	By early/mid October
Hilary Ockendon	Make MI-NET review of KE mechanisms available to partipants	When available
Dawn Wasley	Undertake feedback exercise of meeting	Late October

Day 2 - Mini-Study Group Day (led by Geoff Evatt, University of Manchester)

For the second day it was agreed to give people the opportunity to try out at a KE mechanism used at the University of Manchester.

The University of Manchester uses a format similar to a Study Group. It involves a single company with multiple problems. The company has to provide at least 1 person per problem.
The department aims to provide a mix of academics/students - typically about 30. The nominal cost is £3k - and there is the option to have a mini-study group activity and get a *free* MSc.

Aim to have a wide range of academics involved. On doorstep, only 1 day - removes a lot of the normal barriers for involvement. One of the tasks can be to 'kill off' problems that aren't suitable, which can be valuable for the company Has been really successful way of bolstering industrial relations and GE assured us it was 'easy' to get people involved.

For the day, 3 problems were put forward by Tim Myers, Poul Hjorth and William Lee. These represented a mix of problems, all based on real problems posed in a Study Group environment.

Each problem leader gave a 10-15 minute introduction.

Problem 1: Rapid Quality Checking of Widget X
Problem 2: Bubble Formation in an Ink Jet Printer Head
Problem 3: Nanoparticle Size Focussing

The attendees were then arranged into groups of 4-5 people, and spent the rest of the day working on the problem and considering the approaches.

At the end of the day, the groups reconvened in the lecture theatre and discussed the progress made and next steps.

In each case, progress had been made. In some cases a similar approach to that achieved in the study group was made - in others a new approach was detailed.

It was clear to see how if a single company had brought a range of problems, then after a day there would be lots to discuss and potential routes for future collaboration.

It was interesting for people involved in study groups to see how the 1-day option worked, and for those unfamiliar with the format to get a feel for how study groups operative.

One of the main reasons behind the activity was to let people try it out and consider if it could work in their home dept/place of work etc.

Feedback from one participant, previously unfamiliar with the format *"I found the exercise very interesting in the sense that there was a range of problems which could be tackled by a variety of backgrounds and experience in industrial problems. I think the atmosphere in my group was comfortable and open which I found was important to allow for ideas to be put forward and make the best of the analytic thinking of mathematicians. I think it would be an interesting approach to explore how one could apply the idea of a study group to cross- or even intra-disciplinary research projects within academia."*